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ANCESTORS OF THE KARAKUL BREEDS

At the left is a black Danadar ewe, which as is easily seen is a *longtail*. Anatomically it greatly resembles the Small Arabi Karakul, which has been produced from it by the admixture of fatrump and other blood. This ewe shows a considerable admixture of fine wool. At the right is a gray Danadar, also a longtail. The gray Danadar breed has been produced by crossing white, fine-wool Afghan sheep on the black Danadar, and consequently represents one step in the creation of the Karakul (small Arabi) breed which is so highly valued today. (Frontispiece.)

[See "Origin of Karakul Sheep," p. 445.]

NATURE OF MENDELIAN UNITS

All Extensive Researches Indicate that so-called Units are Groups of Very Small sub-characters, and not Indivisible Units—Alternative Inheritance no Evidence of Discontinuous Evolution—Importance to Eugenics of Understanding True Nature of Characters.

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THE discontinuous nature of Mendelian inheritance is often taken as evidence that evolutionary progress is also discontinuous. When two varieties appear to differ in a single conspicuous character and this character is found to behave as a unit in the progeny of crosses between the two forms, it seems reasonable to infer that the character sprang into existence abruptly. The failure to secure intermediates among the hybrids certainly suggests that there was a corresponding absence of intermediates when the character arose.

This line of reasoning has not gone unchallenged, but most Mendelians continue to look upon characters as units and many are so unbending as to continue in the belief that the units are unchangeable. It is the purpose of the present paper to discuss the bearing of Mendelian inheritance on the origin of characters and to suggest an extension of the theory of factored characters. Reasons are advanced for believing that all visible characters are complexes of minute sub-characters which have become coherent through long association.

During the years immediately following the revival of Mendel's discovery, many alternative characters were investigated and the crosses were regularly reported as showing no intermediates and as giving in the second generation the 3 to 1 ratio of the simple Mendelian hybrid. Results of this kind are most easily explained by assigning to the germ plasm a single representative for each character. As the study of these hybrids was continued with more minuteness, and crosses were made with types possessing characters different from either of the original alternative pair, dihybrid ratios were reported with increasing frequency. A dihybrid ratio is interpreted as indicating that the character, instead of being simple, is in reality a combination of two sub-characters or factors. These factors when considered singly still behave as simple Mendelian units, but the combination necessary to produce the original character will occur in other than the 3 to 1 ratio. The instances where the slightly more complicated dihybrid ratios were followed with approximate exactness were sufficiently numerous to warrant continuance in the belief that the law of complete and equal segregation was of very general application. But there were also many alternative characters which showed by the still more complicated hybrid ratios that the original characters must be represented by three, four or even more factors. With more than three factors, it has seldom been possible to conduct experiments on a sufficiently large scale to determine whether the ratios are followed with exactness or not. The fact that individuals occur in the later generations of the cross which reproduce the character in its original form, and that some of these breed true, at least for several generations, affords evidence that we are still dealing with a complicated form of the originally simple law.

THE LIMIT OF ANALYSIS.

From characters composed of only three or four sub-characters, there is now perfect gradation to characters, such as height and weight, where the different stages, if they exist, are com-

pletely masked by fluctuations. In crosses involving such characters as height, even the reappearance of the characters in their original form can not be verified, and the only evidence that we are still dealing with Mendelian phenomena lies in the fact that the blend of the first cross does not persist and the extremes represented by the original parents of the cross are attained or even exceeded in the subsequent progeny of the cross. It seems not illogical, however, to assume that the differences, though very minute, are still inherited in the same discontinuous manner. That we have passed the limit of analysis is certainly no reason to assume that we have passed outside the realm of law.

It has been shown, however, that the Mendelian behavior of minute differences would produce results in accord with continuous evolution and Galton's law of inheritance. The possibility of reconciling Mendelian inheritance with Galton's laws was early recognized by Yule.[1]

While the inheritance of blended characters, such as height, may be brought into accord with Mendelian inheritance by the assumption of a sufficiently large number of factors, such inheritance can be held to be discontinuous only in the sense that curves are held to consist of a series of straight lines. An array of variations may fit the normal curve of continuous variation and at the same time comply with the Mendelian laws of discontinuous inheritance, provided only that the differences between the units are sufficiently minute.

To return now to characters which are inherited in a conspicuously discontinuous manner, is it not possible that here the individual stages in the development of the character are also numerous and extremely small? There are still many gross characters that stand as simple Mendelian units, but few, if any, of these occur in plants or animals that have been subjected to extensive investigation. There is now such a large number of characters which at first behaved as units, but which have since been broken up by crossing with suitably selected material, that it seems not unreasonable to believe that the remaining cases await only the discovery of the right strains with which to hybridize them to bring about corresponding results. Even if the strains necessary to subdivide the characters no longer exist, we may still look upon the residue of "unit characters" as composed of an indefinite number of "factors," which arose independently but are now inseparably associated.

One of the best examples of a single Mendelian character is the horny endosperm of the seeds of certain types of maize, as contrasted with the wrinkled endosperm of the sweet varieties. The simple Mendelian ratio that follows the crossing of the sweet x horny varieties has been demonstrated with greater exactness than for any other character pair. Taking only the results of Lock, East and Hayes, and Halsted, the number of individuals classified reaches nearly 100,000. With numbers of this magnitude, deviations from the expected 3 to 1 ratio as small as one-half of one percent. could be detected with assurance. Many different varieties have been crossed and always with the same result: the difference between wrinkled and horny endosperm behaved as a simple Mendelian unit. When, however, a variety of maize with an endosperm that was neither horny nor wrinkled came to be crossed with sweet varieties, a horny endosperm was formed which segregated in accordance with a dihybrid ratio, showing that this character, which had behaved with such wonderful regularity, appeared as a unit simply because it had not been resolved into the elements or factors of which it was really composed.

That we have not yet found a variety of maize that will still further subdivide these endosperm characters is slight reason for assuming that the

[1] New Phytologist, Vol. 1, Nos. 9 and 10, 1902.

A mathematical demonstration of the close agreement between the Mendelian behavior of minute factors and Galton's law has been given by Brownlee, 1910: Proc. Roy. Soc., Edinburgh, 30, P. 473, and 1911, 31, P. 251.

factors, as we now understand them, are ultimate and indivisible or that they originated by single steps.

COMPLEXITY OF CHARACTERS.

Even the simplest visible character is of such a complex nature and requires the interaction of so many elements that the simultaneous origin of the individual elements, all properly correlated, is difficult of conception. The possibilities of subdivision are not limited, even to visible factors. Analytical breeding has shown that many of the elements of a visible character, if they exist alone, are entirely invisible. Factors for pattern and intensifying factors may be combined, segregated, and recombined, and yet give no visible evidence of their existence until united with the necessary factor for pigment. In many instances this subdivision into factors continues to the limit of our ability to analyze, and beyond this point we have no way of knowing to what degree of minuteness subdivision may extend. One result of this class of investigations is to bring to our minds a realization of the multitude of diversities that actually exist, but concerning which our senses give us no direct intimation.

The problem of evolution has been attacked from one side by biometricians and others adhering to the idea of gradual change, and from the opposite side by the followers of De Vries and Mendel. The field between them has been narrowed until the two forces are now within sight of each other. There are still many points of divergence, but all that remains of the question as to whether or not evolution proceeds by abrupt steps is a different terminology and a different point of view. If the individual steps by which evolution proceeds are too small to be distinguished, the question whether evolution should properly be termed continuous or discontinuous is chiefly of academic interest.

The futility of the distinction between blended and discontinuous inheritance has been appreciated by Reid:[2] "Adherents of the Mendelian doctrine sometimes maintain that blended inheritance is nothing other than a fine mosaic. Doubtless they are right; but I imagine their opponents mean nothing more by blended inheritance than that it is a very fine mosaic—a mosaic as fine, perhaps, as the mixture of colours in a painter's brush. All blending, for example a mixture of alcohol and water, is a mosaic, even if one of chemical molecules."

With the idea of illustrating how this common viewpoint may be applied to characters that behave as simple Mendelian units, the evolution of a hypothetical character may be traced.

In the palms, the pinnate type of leaf is held to have developed from forms with palmately divided leaves. In the typical palmate leaf, such as Chamaerops, the veins all arise from the tip of the petiole. Let us assume that in a geographically segregated group, the tip of the petiole or point of origin of the veins becomes gradually elongated. This elongation continues until the pinnae are finally separated and the pinnate type of leaf is attained. The magnitude of the individual steps by which this development proceeded, we assume to have been as small as the differences now observed between individuals of existing species. If now a palm of the pronounced pinnate type, such as Cocos or Phoenix, could be crossed with a Chamaerops, the type of leaf would doubtless Mendelize, perhaps without intermediates. It would then be assumed that the difference in leaf form was represented by a unit character and that this difference represented a single step in evolutionary progress. If, however, some species with a third type of leaf should come to light, say such a plant as Sabal, that has a leaf intermediate between the palmate and pinnate types, and this new form could be crossed with the Chamaerops or Phoenix, it would then be found that the leaf character separating Chamaerops from Phoenix consisted of two factors, each of which might still be found to Mendelize, thus halving the apparent evolutionary step. Further subdivision of the character would depend on whether

[2] Reid, G. A., "The Laws of Heredity," P. 155, footnote.

other types could be found representing still other stages in the evolutionary development or possessing a different assortment of factors. If a sufficient number of these intermediate types were available, the forms would increase until the differences became so small that, although the different stages might still behave as Mendelian units, the fact could not be definitely demonstrated.

THE LAW OF SEGREGATION.

Looked at from this standpoint, the law of segregation may be said to hold good. The difficulties and inconsistencies in its application have resulted from the assumption that visible differences are "unit characters" represented by single determiners. According to the interpretation here advanced, visible characters are to be looked upon as complexes of an indefinite number of heritable elements which are so small as to be immeasurable and which are more or less tenaciously united. On the degree of coherence, or tenacity with which the elements are bound together, depends the apparent regularity of the Mendelian behavior. If the elements remain inseparably associated, the inheritance follows the simple monohybrid ratio. If the elements separate into two or three groups, di- or trihybrid ratios result. If the association of elements is still more completely dissolved, the inheritance is blended and apparently non-Mendelian. On breaking up the characters, smaller groups of slightly coherent elements may form, and these groups themselves may not be entirely independent. It is thus possible to account for cases in which indications of both mono- and dihybrid ratios occur with respect to the same visible character. With characters that are strictly alternative in their nature, dissolution results in aberrant or complicated ratios. Where intermediate stages of the characters can come into expression, dissolution results in indistinct classes and apparently imperfect segregation.

The difference between the waxy and horny endosperm of maize affords a good example of a character whose expression is definitely alternative. Intermediate forms are completely absent, the nearest approach to an intermediate being the extremely rare occurrence of seeds in which both horny and waxy endosperm are present as a mosaic. The inheritance of endosperm texture in horny x waxy hybrids behaves as a simple Mendelian character, and this behavior was thought to be perfectly regular until the use of larger numbers of individuals made it possible to determine the ratio with greater accuracy. It was then found that instead of the mean percentage of waxy seeds being the expected 25, it was in reality only about 23.

If the coherence between the various genetic variations that result in changing waxy to horny endosperm was absolute the Mendelian behavior of the characters would be regular, but if one or more of the elements was occasionally disassociated from its fellows there would result a variation from the expected 25% of recessives.

The change from waxy to horny may be likened to a chemical change that accompanies the transition from an acid to an alkaline reaction, or the change from a solid to a liquid state that follows a rise in temperature. The increase in alkalinity or the rise in temperature may be slow and continuous, but the resulting change in appearance is abrupt

MANY CASES REPORTED.

Examples of coherence and the factoring or subdivision of characters are constantly being reported. Castle has shown that some Mendelian characters are amenable to change by selection. The latest results in this line are those of Castle and Phillips. In a series of carefully planned experiments, it is shown that the hooded character in rats, which exhibits perfectly blended inheritance between different stages or degrees of the character, may still behave as a unit, giving monohybrid ratios when crossed with forms not showing the character.

After changing the mean of the hooded character in both directions by selection, individuals were crossed with the wild stock which is not hooded. The wild form is dominant and the

hooded character reappears in one-fourth of the progeny in the second generation. The result of the crossing, however, appeared to undo the work of selection. Thus, when a member of the strain in which the amount of white had been increased by selection was crossed with the wild type, the extracted hooded individuals showed less white than the hooded parent; and when a member of the strain in which the white had been reduced was used, the extracted hooded individuals showed more white than the hooded parent.

That typical Mendelian characters are amenable to change through selection is held to prove that unit characters are variable. The apparent undoing of the work of selection by crossing with the wild type has induced the authors to grant the probable existence of "modifiers," but the "main factor" is still considered as a unit. May not the results of these experiments be brought into closer harmony with those of other investigators if this "main factor" is looked upon as a rather tenacious group of minute factors similar in nature to the detached "modifiers"?

Paleontological records afford further evidence of the gradual evolution of characters that are discontinuous in inheritance. While the evidence from this source is direct, geological records are seldom sufficiently complete to observe differences as minute as those brought to light by analytical breeding. Professor H. F. Osborn has carefully traced the development of cranial and dental forms in some of the mammals. He shows that a number of the characters that distinguish the horse from the ass afford no evidence of discontinuous origin, but appear to have developed gradually from very small beginnings. Yet there is evidence that the resulting differences, as they now exist, behave as units. The sterility of the hybrid has made it impossible adequately to test the Mendelian behavior, but Professor Osborn shows that these characters exhibit the phenomenon of dominance in the first generation. The behavior is thus shown to be Mendelian as far as it goes. Professor Osborn says:

"It is true that the evidence for discontinuity in the *heredity* of characters is as convincing as that for discontinuity in the *genesis* of character is debatable," and some characters "while apparently continuous in origin certainly become discontinuous in heredity; from which it follows that discontinuity in heredity constitutes no proof of discontinuity in origin."[3]

A WARNING TO EUGENISTS.

Once the complex nature of visible characters is fully appreciated, less confidence will be placed in the purity of the germ cells. Is it safe to assume that an undesirable character introduced into a hybrid with one of the parents has left no trace or tendency in those members of the progeny which on Mendelian analysis show the alternative character? Since the rediscovery of Mendel's laws, this question has been acute, but most practical breeders still remain skeptical. With the greatly increased interest in eugenics, the importance of deciding this question is brought home to a large part of the thinking public. In the light of recent research, for one to assert with confidence that a heritable human defect, which investigations have shown to be a dominant character, is completely absent from offspring that fail to show the defect, regardless of its prevalence among their ancestors, indicates a complete failure to appreciate a grave responsibility. Mendel's laws may be inexorable, and yet all the elements which go to make up a physiological or mental defect may not always remain associated.

Complete analysis of characters in man is impossible at present, and expectation regarding the behavior of undesirable characters must be largely inferred from analogy. So many of the characters which in other species have been exhaustively studied have been found resolvable that it appears unscientific as well as dangerous to assume that the segregation of gross pathological characters is complete in the human species. Individuals that are pure recessive with respect to what appears as a simple

[3] Osborn, H. F., The Continuous Origin of Certain Unit Characters as observed by a Paleontologist. American Naturalist, 44, 186-7.

Mendelian character may still carry some of the elements of the character. There are no pure strains in the human species, and any union may bring together the complementary elements that will cause an undesirable character to come into expression.

A Warning to Eugenists

Condemnation of haste in "eugenic" legislation is voiced by the State Charities Commission of Illinois in its fourth annual report. The commission says:

"We do not favor the enactment into laws of the principles which the eugenist has promulgated. They are worthy of public thought and consideration. But whatever of merit they contain, to be effective, must be accepted voluntarily by an enlightened and quickened public conscience, and not forced upon it by statutory enactment. Much more can be accomplished in this field by the dissemination of clearly demonstrated facts than by attempt to impose by law upon the public poorly understood or wholly misunderstood principles of human conduct and life.

"Many eugenists are going to extremes. They are responsible for the ridicule into which a serious subject has been plunged. The science of eugenics is a dignified, deep and serious study of the tremendous problems of human life. It is entitled to respect and to respectful consideration. The popular conception, formed through flippant reference to eugenic marriages, eugenic babes, eugenic dramatic productions and eugenic novels, has resulted in its falling into more or less disrepute.

"The pioneers in the science have advanced ideas which are worthy of the most careful thought, whether we believe in them or not. Any movement whose object is to improve the race, elevate the standard of mentality and make life better and nobler, should not be prostituted as this science has been."

The Wisconsin Marriage Law

The weekly Report of the United States Public Health Service (Vol. 29, No. 37, Washington, D. C., Sept. 11, 1914) publishes the opinion of the chief justice of the Wisconsin supreme court, upholding the so-called "eugenic marriage law" and also the dissenting opinion rendered by two of the members of the court. The law, which has been in force since the beginning of this year, and provides for a medical examination of "all male persons making application for license to marry," was attacked as unconstitutional, and the court of first trial upheld the attack. In the supreme court "the case really turned on the question whether or not the language of the law required the application of the Wassermann test. . . . The majority of the court held that the legislature did not intend to require the Wassermann test." The statute as thus interpreted would appear to be even more useless than its opponents have from the start declared it to be.

TREE GROWTH AND SEED

Swiss Experiments Show How Main Characteristics of Parent's Growth are Inherited by Seedlings—Seed Must be Selected with as Much Care in Forestry as in Horticulture—Limited Effects of Environment in Overcoming Bad Heredity.

JAMES B. BERRY
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AT THE Forest Experiment Station near Zürich, of which Dr. Arnold Engler is Director, are a number of interesting investigations under way[1] which illustrate the inheritance by seedlings of the main characteristics of the parent tree. No plant breeder doubts this in the least, yet the fact remains that the purchaser of tree seed seldom questions its source, and then as to region only. For instance, two plots are covered with a good growth of spruce seedlings varying in height from three to 10 feet. The seedlings on Plot I show more than 50% crooked and twisted, unfit for the production of high class material, while Plot II contains less than 5% of material of this character—a variance at once noticeable. Inquiry as to the history of the two plots brings out these facts:

1—that the seedlings on Plot I originated from seed collected from a mother tree of gnarled and twisted form—yet not an extreme form.

2—that the seedlings on Plot II originated from seed collected from a mother tree of normal form.

3—that the two mother trees—the deformed and the normal—occur in the same quality site under similar conditions of light, heat and moisture.

A second experiment occupies two adjacent plots, both supporting a growth of spruce seedlings about fifteen years of age, the planting distance being the same in the two cases. The seedlings on Plot I, while entirely healthy and vigorous, are rounding in form, very dense in character and the branches are uniformly small. Plot II supports a growth of seedlings entirely normal in form and rate of growth. The seedlings on Plot I ranged between 12 inches and 30 inches in height, and were as broad as high; the seedlings on Plot II ranged between three and six feet in height. The history of the plots brings out these facts:

1—that the seedlings on Plot I originated from seed from a mother tree which was characterized by density of branching and slow growth, but of normal form.

2—that the seedlings on Plot II are the product of seed collected from a mother tree of normal form and growth.

3—that the two mother trees—the dense and the open, the slow growth and the normal—occur on the same quality site under similar conditions.

Spruce forms the basis, also, for a third investigation; namely, the effect of temperature in its relation to transmitted characteristics. Seed was collected from regions of mean temperature varying by 10° F, from that of Zürich to northern Sweden, altitude and latitude both forming a basis for computation. Two or three rows were planted from each lot of seed, the arrangement being in regular order from the lowest to the highest mean temperature. Today, eight years after the inauguration of the experiment, there results a "terrace"-like formation, the relative height growth varying directly with the mean temperature. Another interesting feature of the same experiment is that it brings out the fact that the length of

[1] See also Engler, Arnold. Influence of Source of Seed. Journal of Heredity, V, 4, 185, April, 1914.

SCOTCH PINES AT THE ZÜRICH STATION

In the United States the Scotch pine (*Pinus sylvestris*) is frequently said to give very poor results. Seedlings grown at the Zurich experiment station, however, from very diverse sources, indicate that with proper seed selection, good stands can nearly always be obtained; and observation in many other localities on the continent, under all sorts of conditions, confirms the belief that if seed from good trees and suitable regions were selected for planting in the United States, the Scotch pine might be considered very successful. The influence of the source of seed on the character of tree growth has long been neglected, but is now beginning to receive the attention it deserves. (Fig. 1.)

GROWTH HABIT OF THE NORWAY SPRUCE

Important conclusions as to the effect of environment on seed are being drawn from a study of the Norway spruce at Zürich, Switzerland, by Arnold Engler. It is found that seeds collected from trees of normal, open growth reproduce this habit, while seed collected from trees of stunted, twisted, or gnarled form tend to produce trees almost worthless for lumbering purposes. It is also found that seed from high altitudes produces trees that have a short growing season, even when planted in much lower altitudes. The importance of seed selection thus becomes as great to the forester as it long has been to the gardener. (Fig. 2.)

growing season becomes a fixed character of tree growth; that is, that the length of the period of active growth varies directly with the mean temperature of the plant's habitat. Thus, the plants, resulting from seed from a locality of high mean temperature, are the first to show active growth in the spring; while those resulting from seed from a region of low mean temperature will be last. A shorter growing season is also characterized by a lower annual increment as well as by density of form.

APPLYING THE CONCLUSIONS.

The practical application of these facts is easy, and here is also found an explanation for some of the poor results in forestry. For instance, it is said that Scotch Pine (*P. sylvestris*) gives very poor results in the United States and that, therefore, it is not adapted to this country. It is true that in Europe one does find poor stands of this species, yet, on the other hand, there also occur very fine stands. Other conditions being the same, does it not seem reasonable to place the blame upon the source of seed?

In a region where the snow-fall is heavy and the snow is of such a character that it c ings to the branches and leaves, producing heavy damage through snow-break, the seedling resulting from

seed from a region of higher mean temperature is most affected, since the long, willowy, previous year's growth is easily forced out of shape, becoming a cripple if not actually broken. Because of the longer period of growth these seedlings are also more liable to damage through early and late frosts. These facts are now generally accepted by German foresters and, in mountainous regions, it is common to find a forest nursery for each 500 feet of elevation, the object being to collect the seed and grow the seedlings under conditions common to that general elevation. The suggestion has been made that the nursery should be at a high elevation, yet this is considered as impracticable as having it at a low elevation. In one case the rate of growth is too slow; in the other, the susceptibility of damage and destruction is too great.

Certainly these facts should have a very great influence in the selection of seed, yet the contrary seems the rule. Commercial seed is collected, not always from the best formed and most vigorous, but often from the deformed and dwarfed; simply because the inferior specimens often produce the heaviest crops of seed and this seed is more accessible to the collector. With the same faulty method of reasoning the lumbermen, and often the Forest Service, leave the deformed, the cripples and the weeds to provide for the new forest. Garden and field seeds are being constantly improved through selection and the various State Experiment Stations have undertaken an inspection of seed handled by the large dealers, so that the purchaser may have some guarantee of cleanliness and purity. With tree seed, however, nothing but cleanliness is considered, the character of the parent trees being entirely ignored. Even in work performed by the Forest Service the object has been, too often, "cheap" seed, rather than from the "best" trees. Collecting seed of the trees of a forest indiscriminately is on a par with selecting seed corn as it comes from the sheller. As a matter of fact the selection of tree seed to reproduce a forest is perhaps more important than the selection of seed grain to produce a field of grain, since the profitability of forestry is dependant to so great an extent upon rate of growth and length of rotation. While it may not be possible to have a "seed plot" as in corn growing, it is certainly possible and practicable to gather seed from well-formed, vigorous, rapid-growing individuals only—always bearing in mind that the characteristics desired in the new forest must be present, to a large extent, in the individual parent trees from which the seed is selected. Only to a comparatively small extent can the defects of poor seed be overcome through cultivation.

EUGENICS IN GERMANY

Society For Race-Hygiene Adopts Resolutions Calling For Extensive Program of Positive Measures to Check Decline in Birth-Rate.

G. VON HOFFMANN,
Austro-Hungarian Consul General at Berlin, Germany.

THE GERMAN Society for Race-Hygiene, Munich, founded in 1905, at its last annual meeting in Jena discussed the declining birth-rate and published a series of resolutions on the subject. The topic was chosen in view of the fact that restrictive eugenics ordinarily dominate similar assemblies and the literature, thereby causing in the public the wrong impression that positive eugenics are of a subordinate importance. The chief difference between the resolutions of the Society and utterances on the same subject coming from other sources is found in laying more stress upon the inner moral forces of men. It is not necessary to emphasize that although the danger of the declining birth-rate is great in Germany, the decline is even worse in many other countries.

The resolutions are the following:

A. THE SITUATION.

1. The future of the German people is at stake. The German Empire can not in the long run maintain its true nationality and the independence of its development, if it does not begin without delay and with the greatest energy to mould its internal and external politics as well as the whole life of the people in accordance with eugenic principles. Most important of all are measures for a higher reproduction of healthy and able families.

2. The rapidly declining birth-rate of the healthy and able families necessarily leads to the social, economical and political retrogression of the German people.

3. The insufficient reproduction is partly caused by the encroachment on the reproductive faculty of gonorrhoea, syphilis and alcohol.

4. But the main cause of the declining birth-rate is at present the *increasing wilful restriction of the number of children*.

5. The most important motives for the restriction of the number of children are:

(a) The fear of economic disadvantages and of the difficulties attending care and education of children in consequence of a large family,
(b) considerations of inheritance,
(c) the impossibility to reconcile women's out of home work with the education of a large number of children,
(d) the embarassment caused by the housing systems in large cities.

6. The decline of the birth-rate is greatly hastened by the shamelessly advertised manufacture and organized sale of means preventing conception or causing abortion and by the propaganda of Neomalthusianism.

B. PREVENTION.

In order to secure a posterity sufficient in number and ability, the German Society for Race-Hygiene demands:

1. Furtherance of inner colonization [back-to-the-farm movement] with privileges of succession in favor of large families.

2. Creation of family-homes for large families in cities (garden-cities, small cottages with gardens, etc.).

3. Economic assistance of large families through payment of a substantial relief to married mothers who survive their husbands, and consideration of the number of children in the payment of public and private employees.

4. Abolition as far as possible of certain impediments to marriage which

in European countries are now imposed on officers in the army and government employees (for instance, they cannot marry before the attainment of a certain grade).

5. Increase of taxes on alcohol, tobacco and luxuries for purposes enumerated in No. 3. (A tax is further asked to be imposed on all who on account of their physical inability do not serve in the army. Such a tax exists in Austria, Hungary and Switzerland.)

6. Legal regulation of procedure in all cases necessitating abortion or sterilization. (This means that the medical indication should be made more stringent, for instance by the provision that two physicians be consulted before an operation is executed. The sterilization for eugenic reasons is covered by this paragraph, but has not been specifically included, as the time has not yet come for such a measure in Germany.)

7. Fight against all evils encroaching upon the ability to reproduce, in the first place against gonorrhoea and syphilis, tuberculosis, alcoholism, industrial poisons and evils endangering the health of working women.

8. Obligatory exchange of certificates of health before marriage.

9. Setting out large prizes for excellent works of art (novels, dramas, plastic arts) which glorify the ideal of mothership, the family and simple life.

10. Awakening a national mind ready to bring sacrifices, and a sense of duty toward coming generations. Vigorous education of the youth in this sense.

The German Society for Race-Hygiene earnestly applies to all who are convinced of the correctness of these principles, for cooperation in order that the needed legal measures be enacted before it is too late.

For an Exhibit of Hybrids

In connection with the annual meeting of the American Genetic Association at San Francisco in September, 1915, it is proposed to give members an opportunity to exhibit interesting hybrids, either of plants or animals. These will probably be installed at the University of California, where an unusual series of cross-bred forms of tobaccos and walnuts will be shown. The Association will undertake to care for exhibits sent, but can not assume any expense in connection with their transportation. The secretary will be glad to hear from members who can contribute interesting productions for this display.

HOLSTEIN MILK YIELD

Examination of Records in Blue Book Furnishes no Support to Idea That Milking Capacity in Cows is Transmitted Through Males Rather Than Females.

F. R. MARSHALL,
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THERE seems to be a growing tendency to direct the study of inheritance to a greater extent along utilitarian lines. It is quite possible that some of the principles that obtain in inheritance of coat characters may also apply to capacity for certain kinds of work or production, or at least to factors that contribute to such capacity.

While actual tests and specially planned matings are altogether necessary and desirable, yet there is considerable material at hand that may profitably be studied until more desirable data is available. Such material is contained in the Year Book for the American Trotting Register, which shows the records of all horses that have trotted faster than 2:30, arranged under their sires and dams. This book does not record the non-performing offspring of any matings. In its present form the Year Book was regarded by Galton as furnishing material of value for statistical study, as evidenced by the use he made of the same.[1]

The Advanced Registers for dairy breeds of cattle also show what animals have met prescribed standards and give opportunity for tracing their ancestry and knowing the records of the ancestors. Here too we are dealing with selected material, as there is no mention of non-record-making offspring. The study reported in this article relates to inheritance through paternal and maternal lines, of factors controlling the production of butter fat.

The work was done by Perry Van Ewing, now with the Georgia Experiment Station, and was presented as the thesis requirement for a M.Sc. degree granted by the Ohio State University in 1913. It is a continuation of another study made at that institution by W. O. Reagin and reported in the American Breeders' Magazine.[2]

Ewing's results are of special interest in connection with Cole's reference[3] to the prevailing impression that, "the males of dairy breeds, generally, are prepotent in the transmission of the characteristics of the females of their race." It was the foregoing statement that first suggested an examination of records of cows as reported in the Blue Book compiled annually from the Advanced Register for the Holstein Breed. In Volume 10, there were found 1317 cases of cows having official records and whose paternal grandams also had records. In addition, there were 687 cases in which a record-making individual had a maternal grandam with a record. These were all seven-day records, made

[1] Proc. Royal Soc. London, Vol. 72, no. 384, pp. 310–315. 1898.

[2] Vol. 3, No. 2, p. 148.

[3] Vol. 4, No. 3, p. 160, American Breeders' Magazine. "Among cattle breeders we find a prevailing impression that 'the males of dairy-breeds, generally, are prepotent in the transmission of the characteristics of the females of their race' (Miles, op. cit., p. 231). Sedgwick is quoted in the same place as saying: 'It is well known, for example, that the supply of milk by cows is hereditarily influenced by the bulls rather than by the cows from which they are directly descended, and that the character of the secretion, as regards both the quantity and the quality of the milk, is chiefly derived from the paternal grandmother * * *.'

"This, if true, would fit in well with sex-limited inheritance, and such indeed it may ultimately be found to be."

at various ages and giving the pounds of milk yielded, pounds of fat and per cent. of fat.

The difficulty of variation in age was overcome by arranging the "paternal grandam" and "maternal grandam" cards in two parallel sets. Having a much larger number in the paternal set it was possible to select therefrom, for each maternal card, one in which the age of the cow and of the grandam corresponded very closely. This arrangement left 665 cards in each group.

The coefficient of correlation for each group in respect to total milk, total fat and per cent. of fat, is shown below:

SUMMARY OF RESULTS.

	M	Em	σ	Eσ	r	Er
Pounds of Milk						
Through Sires						
Granddaughters	370.6	±2.29	88.5	±1.67	−0.05	±0.025
Grandams	475.3	±2.56	98.7	±1.95	−0.05	±0.025
Through Dams						
Granddaughters	393.4	±2.63	99.5	±1.95	−0.012	±0.02
Grandams	437.4	±2.09	80.8	±1.54		
Pounds of Butter-fat						
Through Sires						
Granddaughters	12.68	±0.089	3.41	±0.062	−0.04	±0.025
Grandams	16.93	±0.108	4.14	±0.076		
Through Dams						
Granddaughters	14.00	±0.101	3.97	±0.07	0.06	±0.026
Grandams	15.83	±0.087	3.31	±0.06		
Percentage of Butter-fat						
Through Sires						
Granddaughters	3.47	±0.009	±.432	±0.008	0.107	±0.02
Grandams	3.57	±0.011	±.448	±0.008		
Through Dams						
Granddaughters	3.55	±0.011	±.445	±0.008	0.213	±0.02
Grandams	3.50	±0.013	±.488	±0.009		

Taking the opposing pairs of cards as they came to see in which there was the greatest similarity between records of granddaughter and grandam the following results were obtained:

	Number cases in which resemblance was closest on Maternal side.	Number cases in which resemblance was closest on Paternal side.
Pounds of milk	403	262
Pounds of Butter-Fat	407	258
Per cent. of Butter-Fat	345	320

In the two sets of cases already discussed there was a smaller number of paternal than of maternal grandams, due to fact that cows have many more granddaughters through their sons than through their daughters. This objec-

tion and the further objection as to environmental influence upon total production is removed in a further study relating entirely to per cent. of butter-fat.

In the second part of the study of this case there were taken 126 record cows having record granddaughters through both sons and daughters. The number of granddaughters is 340 through paternal descent and 340 through maternal descent from 126 common grandams. Each grandam was represented by not less than one nor more than six granddaughters in either line. Here also the ages of granddaughters and grandams in one line corresponded closely with those in the other line. The means, standards of deviation and coefficients of correlation in this case of common grandams were as follows:

Paternal Descent	M: % Fat	E	σ	E		
Granddaughters	3.52	± .02	.442	± .01	$\sqrt{}$	= .157
Grandams	3.51	± .02	.406	± .01	E	0.028
Maternal Descent.						
Granddaughters	3.60	± .02	.489	± .01	$\sqrt{}$	= .155
Grandams	3.51	± .02	.406	± .01	E	± .028

The difference between .155 and .157 does not indicate any difference between transmission of the character of percentage of butter-fat in the milk, through males and females. The impression to the contrary, held by some cattle breeders, is probably based upon specific instances in which the bull used was more strongly bred than were the cows with which he was mated and unusually prepotent on that account.

THE SIAMESE POMELO

Perhaps the Finest in the World—Several Types Seem to be Genuinely Seedless—Occasional Seed-production Probably Due to Cross-pollination.

H. H. BOYLE
Bureau of Agriculture, Manila, P. I.

FOR many years, horticulturists throughout the world have heard stories of a wonderful seedless pomelo in Siam, which was reputed to be finer than anything else of that sort known to science, but which, for some reason, always seemed to elude the long grasp of the men who are engaged in the work of securing new plants for breeders in the various tropical and sub-tropical regions. It was 12 years from the time I first became interested in this fruit to the time when I actually saw it, but it is now established in the Philippine Islands, has been introduced to the United States and will, I believe, spread throughout the warmer portions of the world, as the finest grapefruit cultivated.

As early as 1902, when I was employed in the Office of Foreign Seed and Plant Introduction of the U. S. Department of Agriculture, we secured plants of this pomelo, as the result of a long correspondence carried on by Mr. Fairchild, in charge of the office. Prince Chow, Phya Bhas Karawongse, sent through G. B. McFarland of the Wang Lang Hospital, Bangkok, a Wardian case of six trees propagated from those in the private garden of the King of Siam at Bangkok. Due to the long journey and improper handling en route, only one plant arrived in Washington alive. After being nursed to a healthy state, it was planted in the orange house with much solicitude, for the rapidly increasing interest in the pomelo as a breakfast fruit caused every citrus grower in the United States to take an interest in the introduction.

In a few years it bore several large fruits, which were cut with much ceremony. Imagine the disappointment when it was found that these "Siamese Seedless Pomelos" contained more seeds than the ordinary seedy pomelos of the United States; that the rind, instead of being a quarter of an inch thick (the average for United States pomelos) was at least an inch thick; and that the segments were numerous and tough in texture. In short, the fruit was inferior to any of the recognized varieties grown in the United States, and the one tree was destroyed. For many years thereafter the Siamese seedless pomelo remained an enticing but baffling mystery.

In 1911 I was transferred to the Philippine Bureau of Agriculture, and shortly afterward learned from C. A. Steele, a Siamese acquaintance, that while the seedless pomelo was not common in Siam, it nevertheless did exist in certain parts of the country. A few months later he sent us a small shipment of budwood. In 1912 the Bureau received from a passing traveler a present of four fruits which, upon inspection, fully justified the almost legendary reputation of this pomelo. We had before our eyes the substantial evidence that the famous product was not a myth, as many had claimed, but that it was one of the finest citrus fruits ever propagated.

TRIP TO SIAM UNDERTAKEN.

As a result of this evidence, the Bureau of Agriculture sent me to Siam to study the pomelo on the spot and obtain budwood, plants and fruits.

My first introduction to it in its own home was in the garden of Prince Yugelar, 50 km. northeast of Bangkok, where I met with a type of orchard planting new to me. The trees were all planted on levees, and I soon found that this was the custom not only in

IN A GROVE OF SEEDLESS POMELOS

Part of plantation of Prince Yugelar near Bangkok; foreman of the estate in the foreground. All the trees here shown were supposed to bear seedless fruits, but the third one in the row actually produced pomelos that were excessively seedy. The Siamese strain of seedless pomelos is not very well fixed, apparently, and especially likely to be affected by cross-pollination, but when the fruit is at its best, Mr. Boyle thinks it is probably the best pomelo grown anywhere. A photograph of the seedless pomelo in cross-section was published in the American Breeders' Magazine, IV,4,210, Oct.–Dec., 1913. (Fig. 3.)

Siam, but in many lowland countries in that part of the world. The explanation is that the land has been reclaimed from the sea, by the construction of successive levees about 12 feet wide and six feet high. The space between these is a ditch 12 feet wide and six feet deep, which is used as an irrigation trench, from which water is thrown by men equipped with bamboo paddles, to the trees planted above their heads on the levees. The trees are set about 12 feet apart in the row, the rows being 15 feet apart. The soil is of a very heavy texture, 50% to 60% clay. No cultivation is practiced, other than to keep the levees cleared of weeds.

The pomelos here were inferior to those secured later. Two trees produced pyriform fruits which proved to be absolutely seedless, but on the third tree of the same type in the same row, one fruit out of every half dozen contained seeds. The best fruits which I secured were from Chinese orchards in the Nakon Chaisii district. The largest orchard there contained 48 acres of land, 36 acres being planted with ordinary, seedy pomelos and the remaining 12 acres with trees of the seedless type. The same system of planting was used here as in Prince Yugelar's garden, and the composition of the soil was about the same. All plants are propagated by marcottage, budding being so entirely unknown that the gardeners thought it a practical joke, when shown how to insert buds as the best method of propagation.

I made a thorough investigation of several trees in the seedless section of the grove, cutting open fruits from widely separated points on each tree. All these trees bore seedless fruits, but in some cases seedy fruits were also produced, particularly by trees that stood on the side of the grove nearest the ordinary, seminiferous pomelo trees. The native gardeners believe that the seedlessness of their pomelos is due to the use of salt, a coconut shell full of which is placed around the roots of each tree planted, while brackish water which backs up between the levees is used for irrigation. My own investigation convinced me that we have to do here with genuine seedless types, which however are capable of producing seeds when cross-pollinated. On this theory, the occasional seedy fruits there produced are the result of pollen from trees in the adjoining orchard, carried by the wind or insects to the flowers of the normally seedless trees. The disconcerting behavior of the tree in our greenhouse at Washington, which bore such seedy fruit, is then to be attributed to cross-pollination by some other variety of citrus, of which there were a number in the same greenhouse.

INFLUENCE OF POLLEN.

Due to the shortness of time available for this investigation, I was not able to prove this theory by an investigation of the flowers of the trees in question. But from experience which I gained while working as Assistant in Arboriculture in charge of the propagation of citrus fruits under W. T. Swingle of the U. S. Department of Agriculture at Washington, I am satisfied that this theory fully accounts for the phenomena observed, that it is in accord with our experience on other seedless citrus fruits, and that there is no other theory which will account for the behavior of these pomelos, so simply and comprehensively.

The behavior of navel oranges, in which seeds are very rarely found under normal conditions, seems to me to be an exactly analogous case. E. M. Savage, Assistant Plant Breeder, office of Crop Physiology and Breeding Investigations, who made a large number of crosses of *Citrus trifoliata* on Washington navel oranges in California in 1909, for the purpose of producing new varieties of navel oranges having a frost resistance, tells me that while performing this work in the groves of L. V. W. Brown of Riverside, California, he found a number of navel oranges which bore seeds. These were observed to be growing near pomelo trees, and he believes their seediness was due to the influence of pomelo pollen. Mr. Savage also stated that whenever the navel was from 50 to 100 feet away from the pomelo trees, all of the fruits inspected were found to be seedless.

Similar results were reported in

Florida 20 years ago[1] by H. J. Webber of this Association. He wrote:

"In my experiments, further, a number of navel flowers were crossed with pollen from various other varieties of Citrus fruits. The most notable feature developed in this series of experiments was that in all crossed fruits numerous seeds were produced, while in the fruits produced on the trees normally very few seeds were formed, and in almost all cases none. This commonly seedless character of the navel fruits is, as every one knows, the feature which most recommends this variety of orange.

"In every case where navel fruits developed from crosses, I early marked, nearby on the same tree, young fruits of apparently the same age, and in every way comparable to the crossed fruits other than that they were developed without any treatment whatever as they always naturally do in the groves. They were of course entirely open and may have been pollinated by insects or may have developed without pollination. However this may have been, the fact remains the same that in every fruit thus early marked as checks for comparison, not a single seed was found developed normally. In two or three instances rudimentary seeds about two millimeters long were found.

"The practical suggestion to be derived from the above results is that we should not take means to secure the cross pollination of our navel trees, hoping thereby to secure a larger crop of fruit. The effect of the cross pollination apparently being the production of seedy fruits, but not necessarily more fruits. These are merely suggestions and may have to be modified as more is learned of the subject."

THE SIAMESE OPINION.

In view of this evidence, I have no fear that the Siamese seedless pomelos will not produce seedless fruit, when grown in the Philippines and other tropical countries to which they are adapted. It is interesting to note, however, that all the people in Siam whom I interviewed regarding the seedless quality of the fruit expressed the opinion that it is impossible to get seedless fruits from trees grown anywhere except in the Nakon Chaisii district.

I classified the seedless pomelos of that district in four types, which are quite distinct. In addition to these, there were quite a number of variations in size, shape and flavor, which I tasted in the various orchards. Specimens of all kinds were brought back to Manila, and after 18 days in transit they were in perfect condition. Undoubtedly they will stand long-distance shipment.

Following is a description of the principal characteristics of each of the four types found. It is to be noted that types 2 and 3 are the commonest. Type 4, which is inferior to them, is not very common, while type 1, the finest of all, is quite rare.

Fruit No. 1. Siamese Seedless Pomelo (*Citrus decumana*).

Size: Medium, 4½ inches in diameter by 5 inches in length.
Color: Light yellow skin.
Flesh: White.
Peel: Thin, looser than average. ¼ inch in thickness.
Lenticles: Large and numerous.
Fiber: Delicate; very small amount.
Grain: Standard, loose and fine.
Form: Firm.
Seeds: None.
Taste: Very aromatic; free from bitterness.
Citrus quality proportionate, ideal.
Remarks: In my opinion, the best citrus fruit of the decumana type in existence, both in shape and flavor; excellent for market purposes.

Fruit No. 2. Siamese Seedless Pomelo (*Citrus decumana*).

Size: Medium, $4\frac{7}{8}$ inches in diameter by 3¼ inches in length.
Color: Bright yellow.
Flesh: White.
Peel: Good and firm.
Lenticles: Numerous and even.
Grain: Standard.
Seeds: None.
Taste: Citrus quality pronounced; aromatic and excellent.
Remarks: Excellent fruit for market purposes. These fruits are shipped from Siam to Hongkong.

Fruit No. 3. Siamese Seedless Pomelo (*Citrus decumana*).

Size: Medium, 4½ inches in diameter by $5\frac{1}{8}$ inches in length.
Form: Pyriform.
Color: Orange yellow.
Flesh: Pinkish white.
Peel: Medium; about average.
Lenticles: Firm.
Fiber: Medium.
Core: Large.
Grain: Loose.
Seeds: None.
Taste: Aromatic; rather heavy. Good.

[1] Webber, H. J., 1894. Results in Crossing Navel Oranges, in Proc. Florida State Horticultural Soc. Seventh Ann. Meeting, pp. 62-64. Jacksonville (Tallahassee, Fla. Floridian Pr. Co.).

Remarks: A fair fruit for market purposes, but such pomelos as Marsh Seedless are superior.

Fruit No. 4. Siamese Seedless Pomelo (*Citrus decumana*).

Size: Very large.
Color: Yellow.
Flesh: Deep pink.
Peel: Thick; more than average.
Lenticles: Large and numerous.
Fiber: More than average.
Grain: Small and firm.
Seeds: None.
Taste: Bitter.
Citrus quality proportionately poor.

NEW PUBLICATIONS

Die Züchtung der landwirtschaftlichen Kulturpflanzen, von C. Fruwirth. Band V, Die Züchtung kolonialer Gewächse. PP. viii, 184. Berlin, Paul Parey, 1912. Price, M.10.

This volume of Dr. Fruwirth's encyclopedic work on plant breeding treats in detail of the most important plants cultivated in German's colonial possessions—namely, sugar cane, rice, millet, coffee, cacao, citrus species, cotton and other fiber plants, yams, manioc, peanuts, olives, sesame and the oil palm. Each culture is in effect, monographed by a specialist, Dr. Fruwirth himself being responsible for only a few of the contributions. The book, like all those that Dr. Fruwirth has produced, covers a field not adequately treated by anyone else, and covers it in a way that leaves little to be desired. It is technical in scope, but to genetists who are interested in tropical products from a practical point of view, it should be almost invaluable.

Breeding Australian Opossums

That the Australian opossum (*Trichosurus vulpicula*) might be bred in the United States with profitable results is the belief expressed in a communication from B. Harrison of Burringbar, N.S.W. The name "opossum" applied to this species is almost a misnomer, since he is widely different from the North American animals to which it properly belongs. The Australian opossum is a nocturnal, arboreal animal, living on eucalyptus leaves, tender shoots, and such fodder. He is easily domesticated, and takes kindly to a diet of grain and fruit. His thick and wooly fur commands a ready sale, while the flesh is excellent, particularly if the animal has been fattened on corn. The black Tasmanian opossum yields a still more valuable fur, but Mr. Harrison thinks that either one could be bred easily and successfully in most parts of the United States.

Standards for Graphs

With a view to standardizing the methods of constructing graphs in use by men of science in the United States, so that their construction and interpretation may be simple and uniform, and their use therefore more widespread and popular, the American Society of Mechanical Engineers has taken the lead in the formation of a Joint Committee, to consider the whole subject and make suitable recommendations. As biological as well as physical sciences are now widely interested in the use of graphs, the A.S.M.E. has asked the president of the American Genetic Association to appoint one member of the Joint Committee to represent this association. Charles B. Davenport of Cold Spring Harbor, Long Island, N. Y., has been named to act in this capacity.

ORIGIN OF KARAKUL SHEEP

Black Danadar the Original Fur-bearing Stock of Central Asia—This Crossed with White, Fine-wool Afghan Sheep Produced the Gray Danadar Which in Turn Crossed with Fatrump Sheep Produced the Small Arabi or Karakul Breed—Industry in Turkestan Being Ruined by Natives.

DR. C. C. YOUNG
Charlottetown, Prince Edward Island, Canada.

SOME 26 years ago Dr. Sinitzin, who was at the time employed by the Russian government in Tauria as senior animal husbandman, made a trip to Bokhara in Russian Turkestan and, while there, made an effort to describe the various breeds of sheep that produce valuable lamb skins. Up to that time no attempt had been made by anyone to classify these breeds, and practically nothing had been written on the subject save for the brief mention made by Pallas in his book, in which he so ably described some of the other Asiatic breeds of sheep. It is Sinitzin who first learned that the word *Kara Kul* ("black lake"), was a term not employed by the natives, but that the Russians who came prior to him to Bokhara in quest of fur-bearing sheep, and who were in the habit of making their purchases in the Kara Kul district near the village of the same name, situated near the railway station, on a small river, both of which also bear the name, had transferred this geographical name to the sheep.

It was also Dr. Sinitzin who first gave the world the terms used by the natives in designating certain breeds of fur-bearing sheep: Arabi, Duzbai, Shiraz, and so on. Although he made several grave errors in his classification, he nevertheless deserves credit for having done a large amount of valuable pioneer work.

Dr. Sinitzin describes (1) the small Arabi, (2), the large Arabi, (3), the Duzbai, (4), the Shiraz and (5), the Zigai, among the Bokharan breeds of sheep. He names the small Arabi as the origin of all the fur-bearing sheep of Central Asia, including the Malitch of Crimea, the Tshushka of Bessarabia and the Reshetilev and Sokoliev of Poltova province. According to this theory, the small Arabi is descended from the Mamai, the oldest breed of domesticated sheep, petrified specimens of which, dating back some 8000 years, were found by Duerst in excavating the ruins of Anau (Transcaspia). Sinitzin resorts to the Bible for further history and claims that Jacob won Rachel by knowing how to breed the pigmented sheep that are the pride of the Sarts even today.

But as all Karakul breeds are broadtails (*Ovis platyura*), and as the petrified sheep above mentioned proved to be a fatrump (*Ovis steatopyga*), Dr. Sinitzin's theory can not be taken very seriously. My own experience has shown me that when a longtail sheep is crossed with a fatrump, the result is a broadtail, and while the first cross looks more like a typical Russian fattail (called by the Russians *Jirnochvostaja*), the second and third crosses can not be classified otherwise than as broadtails. I therefore concluded that the Karakul breeds resulted from crosses of longtail sheep on fatrumps. I have often found Karakul sheep, closely answering Sinitzin's description of the Small Arabi, which had rather long tails with so little fat accumulation at the base that the tail resembled that of a longtail sheep, rather than that of a broadtail.

THE TEST OF PIGMENT.

In all these cases that came under my observation, I found that the black pigment in the wool of the *mature* sheep

did *not* oxidize into gray, as is the case with the Arabi *and also with the Duzbai*, so that the specimens in question remained black. I therefore concluded that the small Arabi was a hybrid (and not a very well fixed type of hybrid at that) and that some *black longtail sheep* (the blackest of all black sheep on earth) played an important part in the formation of the breed. Needless to say, I did not exclude the presence of a fatrump admixture—otherwise, how could the small Arabi be a broadtail?

The presence of fatrump blood was easily traced in the Duzbai, which has the long, pendulous, drooping ears that characterize *Ovis steatopyga*, the convex nose line, large head, very thick feet, enormous weight, and a tail with fat accumulation that weighs as much as the kurdiuk (fat sack) of a fatrump. As Duzbai lambs frequently come fawn (the natural color of the fatrump), it is easy to understand why the fatrump's anatomical characteristics appear so dominant in the Duzbai breeds. If a small, black, longtail sheep is crossed with an enormous fawn one (both fixed types), Mendel's law leads us to expect that the offspring will have the characteristics of the latter.

I explained in a former paper[1] that I received most valuable information from the oldest fur dealer in Bokhara, Karavan Bashi Aziz, to whom I was introduced by F. N. Petrov, dragoman of the Russian embassy at New Bokhara. From this gray-haired, honest Musulman I learned that some 60 years ago there were no Arabi nor Duzbai sheep in Bokhara, but at that time the only fur-bearing sheep which produced beautiful, pea-like, tight, lustrous, black curls, was the black *longtail* Danadar. It was not my good fortune to see one of these sheep during my extensive travels in Bokhara in 1912 and 1913, and as I have already explained, the photographs sent me by Mr. Petrov were not sufficient to convince me that the breed really existed at the present day. This spring I was more fortunate and thanks to the Vice-Emir, who provided me with an intelligent guide (Abdul Hamid Bek Mirza Bashi, an officer high in the Emir's employ) I was able to see the only herd of gray Danadar sheep which still exists in the Khanate of Bokhara.

About 100 miles from Old Bokhara city (the capital of the Khanate) there is the district of Kejumek, where we were received by the qazi (the highest judge of the district) who introduced us to a very old sheep breeder of the district, one Kana Abdsiu, who pastured his father's herds of black Danadars and also had his own herd. His grandfather, he said, raised "dogtail" Danadars, and he not only corroborated the story given by the Karavan Bashi Aziz, but added still more interesting information, stating that as the demand began to increase for black Danadar lamb skins (after Bokhara was conquered by Russia in 1865) the natives began to cross their black sheep with white, fine-wool Afghans. This in time produced the *gray Danadar* breed, lambs of which produced skins with small, gray curls the size of pinheads, rather open and lustreless. One such skin is now in my possession. This injection of white blood, contaminated with fatrump blood, in time changed the black Danadar into the small Arabi. The cross of the black Danadar on the fatrump breeds produced the Duzbai. The gray Shiraz evolved from the gray Danadar, and possesses larger curls and more lustre than the gray Danadar, because of its fatrump admixture. The Zigai is a typically Russian breed that never existed in Central Asia, and if Sinitzin saw any there, it must have been because they were taken there by Russian Tartars who settled in Turkestan. Sinitzin's large Arabi, according to Karpov, who wrote the Russian government bulletin on Karakul sheep in 1910, is the same animal as the Duzbai, and I certainly agree with him.

INFLUENCE OF THE DANADAR.

We know now that the black Danadar is to the sheep family what the negro is to the species *Homo sapiens*. There can be no doubt that the Tshushka and

[1] Young, Dr. C. C. Breeding Karakul Sheep. Journal of Heredity, V, 4, 170, April, 1914. See also Strange Sheep of Asiatic Russia, American Breeders' Magazine, IV, 4, 184, Oct.-Dec., 1913, and ibid., third quarter, 1912.

Sokoliev (both longtails) are also descended from it. The Luk-Nakbo breed of Tibet[2] is also closely related to the black Danadar; so is the black Gadik of Afghanistan, some few of which are still found between Mazar-i-Sherif and Kabul. I financed an expedition to Afghanistan this spring and hoped to get photographs illustrating the rare and valuable breeds of that region, as some supposedly trusted Turkomen living in Afghanistan near the Bokharan border town of Kerki on the Amur river had obligated themselves to bring two ewes and two rams (Gadiks) to Kerki, where they were to be turned over to the governor, who promised to ship them on camels to Karshi, where I patiently awaited them. Alas! as there are no honest Turkomen on earth, I lost my money.

As foreigners are forbidden entrance to the military towns of Kushk, Takhtibazar, Kerki, Kelif, Termez and Sarai, on the northern border of Afghanistan, and as I could not get a Russian passport (to which my birth entitles me) without sacrificing my American citizenship, I was again forbidden entrance to those cities, which hold so much of interest to the traveler as well as the sheepman. I did indeed risk arrest for espionage by visiting Kerki, where I obtained an excellent Karakul ram. I was conveyed from Karshi to Kerki in an American Ford automobile, and have some interesting photographs showing how we were pulled out of the drifting sand by camels at several points on the route. Returning, we paid dear for having forsaken the faithful camel, as we nearly perished from thirst.

The ministry of foreign affairs having refused me permission to take any Karakul sheep out of Bokhara for exportation to the United States this year, I have started an experimental farm in Bessarabia, on the estate of Michael Alexevitch Stamatov. During a campaign of four and one-half months I secured 66 head of Karakul sheep from the districts of Karshi, Kerki, Gissar, Tjarjui, Burdalik and Karakul. As I explained in a former paper, the few Karakul sheep in European Russia, which might be secured for export, are all inbred and most of them crossed with Afghan blood to such an extent as to make them worthless. In Bokhara, the Karakul breeds are hastening toward extinction, thanks to the senseless methods of the native breeders, who kill all good lambs and, besides, continually infuse finewool blood from Afghanistan. I am trying to get the Emir of Bokhara to take radical measures to save the industry, and, with the backing of the American and British embassies and Professor Wallace of the University of Edinburgh, have already won the cordial support of the governor-general of Turkestan and the Russian ambassador at New Bokhara. It is highly desirable, however, that these fur-bearing sheep should become established on a reasonably large scale in the United States, by the introduction of reliable stock.[3]

[2] I wish to express my thanks to His Eminence the Chambo Jorje, ambassador of the Dalai Lama, who while visiting the Czar at St. Petersburg kindly received me and furnished me with much valuable information about this valuable fur-bearing member of the black Danadar family.

[3] This communication was forwarded from Karshi, Bokhara, under date of June 1, 1914, Dr. Young later succeeding in exporting 28 sheep which are now in quarantine near Baltimore, Md. —The Editor.

ALFALFA HYBRIDIZATION

Attempt to Improve Plant by Breeding for Better Seed Production and Grazing Qualities—Success in Crossing with the Black Medick—Segregation in the Offspring—Importance of Insects in Pollinating Flowers.

WILLIAM SOUTHWORTH

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FEW forage crops are better known than *Medicago sativa* L.—alfalfa, lucerne or purple medick. It is, perhaps, partly because it is so well known that so little has been done to improve it by scientific breeding.

Its chief value to farmers on the North American continent lies in its capacity to produce large crops of nutritious forage, cut to feed green or made into hay. The crop is occasionally grazed by cattle and sheep, but most practical men agree in the opinion frequently expressed that our present commercial strains are not well adapted for grazing: if the crop is so treated it rapidly loses root and quickly dies out.

Another serious defect in our existing strains of alfalfa, very marked in some districts, is the lack of capacity to produce seed freely. As one of the great essentials of a farm crop is power to produce an abundant supply of seed, it will be readily understood that the shy seeding habit of alfalfa in some districts is a serious drawback to its general utility.

Thus, despite the immense economic value of our present-day strains of alfalfa, there are at least two lines in which their improvement or modification might be undertaken with advantage, viz:

(1). To obtain a strain having the capacity to set seed more freely under a greater variety of soil, climatic, and other environmental conditions.

(2). To obtain a variety which will be better adapted for grazing.

The first part of the problem might be solved by simple selection. Unfortunately, all the types which seem to offer possibilities for grazing appear to be below the average in the capacity to produce seed. Hence it seems unlikely that a complete solution of the problem could be expected by following a course of selection no matter how perfectly the system might be conducted; consequently it was decided to test what success could be accomplished by crossing the alfalfa with another suitable plant in the same genus. The plant which seemed to fulfil most of the conditions required is the common yellow trefoil, otherwise known as black medick (*Medicago lupulina* L.).

THE BLACK MEDICK.

This plant may be described as having slender stems, mostly prostrate, frequently lying flat on the surface of the land; it produces an abundance of fine leaves and these together with the soft and succulent stems yield good grazing but not good hay.

In the United States and in Canada it is usually looked upon as a weed, but in Great Britain and some other European countries it is sown largely for use as a grazing crop and is considered to be well adapted to sheep pastures on dry, upland, chalky and limestone soils. Black medick is only a temporary plant, not lasting more than two years, but is a prolific producer of seed.

As compared with black medick alfalfa may, in general, be called upright in growth, stems fairly stout, bearing many leaves; it is well adapted for cutting for hay and yields heavy crops of rich fodder but is not suited for grazing. It has a very deep root system, is strictly perennial, but under some conditions does not seed very freely.

The general form of the alfalfa flower and the manner in which pollination is

effected have been known for many years. A. P. de Candolle described them in 1832; since then the subject has been investigated by F. Hildebrand, I. Urban, Hermann Müller, Sir John Lubbock, I. H. Burkhill, C. V. Piper and others. There is such a want of harmony in the published results of these investigations, however, that local conditions seem to play an important part in them. Hence each worker must find out what actually takes place under his own environmental conditions, if he expects to achieve success in alfalfa breeding.

To this end experiments were commenced in 1911 at Ontario Agricultural College, and are still in progress. Their aim is the practical one of breeding better strains of alfalfa, rather than the elucidation of any points of merely theoretical interest.

Preliminary experiments were arranged to obtain information on the following points:

(1). When alfalfa is in flower what effect, if any, has the exclusion of bees and other insects on seed production?

(2). If alfalfa flowers be self-pollinated by hand and insects excluded are they sterile or fertile?

(3). If it is the case that insects are essential to ensure fertilization, what species appear to be most successful in performing this operation?

POLLINATION BY INSECTS.

The answer to the first question concerning the exclusion of bees or other insects was of a most decisive character. The results showed that in not one case was a single seed produced when bees were prevented from gaining access to the flowers. Tests were continued throughout a second season with the same results; hence we feel confident in concluding that, in the climatic and environmental conditions under which the tests were conducted, alfalfa flowers are incapable of becoming fertilized when insects are prevented gaining access to the flowers.

With reference to the second question it was found that though alfalfa flowers are protected from the visits of insects, yet if they be self-fertilized by hand a fair percentage of the blossoms produce seed: thus proving that the plants are not self-sterile.

As regards the third question the answer is less simple.

No attempt was made to record all the species of insects which visited the flowers. Various butterflies are very commonly found but apparently they are of no value whatsoever in bringing about fertilization of the flowers. After extended observations it was concluded that the common honey bees are the most numerous visitants, but much to our surprise it was found they have the power to extract the nectar from the flower without liberating the stamens and pistil from the keel. The flower is left intact; consequently no fertilization takes place. In the course of observations extending over three seasons only one case has been seen where a honey bee liberated the stamens from the keel of an alfalfa flower and in this particular instance the bee was enclosed in a cage containing the flower.

The bumble bee is fairly active in fertilizing the flowers; a species of Andrena is apparently very useful, too. But a variety of wild bee belonging to the Megachile group was found to be much more effective than all other insects combined. This bee goes to work as if it enjoyed the task, and as it will pollinate from eight to twelve flowers a minute it will be readily seen that a single bee may visit several thousands of flowers per day.

From the results of our observations and tests we may conclude:

(1). From the structure and mechanism of the alfalfa flower it is incapable of self-fertilization if it is not interfered with by external agencies, natural or artificial.

If however, the stamens and pistil be liberated by suitable artificial means the flower is capable of producing seeds; hence it is not self-sterile.

(2). In nature certain wild bees are most effective in liberating the stamens and pistil, hence when there is scarcity of these bees a very small percentage of flowers are pollinated, the result being a great dearth in the production of seed.

Reasoning from the above observations and experiments we venture to suggest that the shy seeding of alfalfa

THE BLACK MEDICK

This common weed (*Medicago lupulina*) is a rather distant relative of the alfalfa or lucerne (*Medicago sativa*). It is prolific bearer of seed, and also possesses good grazing properties. As ordinary commercial strains of alfalfa are weak in just these two points, there seems reason to believe that a cross with the black medick might lead to the production of a much improved strain of alfalfa. The breeding of such a strain has been taken up by Ontario Agricultural College, with apparently good chances of success. (Fig. 4.)

in certain districts is due to the lack of fertilization of flowers owing to a scarcity of suitable insects to carry out the necessary operation of liberating stamens and pistil from the keel.

BLACK MEDICK SELF-FERTILIZED.

As previously stated, the black medick is frequently regarded as a weed, and most farmers and botanists are well acquainted with its marked capacity to produce seed no matter whether the season is favorable or otherwise. This capacity to seed freely under varied climatic conditions is doubtless owing to its being apparently normally self-fertilized and not requiring the aid of bees or other external agency to ensure pollination.

This property which black medick possesses of producing seed from self-fertilized flowers was investigated by Darwin and in his "List of plants fertile without insect aid," dealing with *Medicago lupulina*, he gives the results of his experiments as follows:

"On account of the danger of losing the seeds, I was forced to gather the seeds before they were quite ripe; 150 flower heads on plants visited by bees yielded pods weighing 101 grains whilst 150 heads on protected plants yielded pods weighing 77 grains. The inequality would probably have been greater if the mature seeds could have been all safely collected and compared."[1]

In recording the results of his own observations made in 1894–5 Burkhill describes[2] the form and mechanism of the flowers of black medick as being similar to that of the common lucerne, but in the flowers of the former plant the stamens and pistil are much more easily liberated from the keel.

In regard to seed-production, Burkhill found that where flowers of black medick were left exposed to the visits of insects 95% produced seed, when enclosed in a net 75% of the flowers set seed.

In the course of our tests (not knowing of any previous investigations having been made on this subject) we enclosed the flowers of black medick in a muslin cage similar to that used for alfalfa flowers.

The object of the test was simply to see whether or not the black medick flowers would produce seed when bees and other insects were excluded. It was found that the protected flowers set seed apparently almost as well as those which were fully exposed. No attempt was made to make an exact count of seeds or pods obtained by the two methods as so many of the pods were lost on ripening it was not possible to make a comparison which would have been strictly accurate.

The above tests all indicate that in black medick we have a plant in which the free seeding propensities are developed to a high degree of perfection. This property, I need scarcely say, is of immense value as a rapid and easy means of reproduction and is a characteristic which if it can be successfully combined with our present strains of alfalfa will so enormously enhance their usefulness that the increase in the value of the crop as a whole can not be well estimated.

THE BREEDER'S PROBLEM.

Having arrived at this point our problem will now be clearly seen as being:

(1). An attempt on the one hand to combine the high crop-producing properties of alfalfa with the free seeding propensities of black medick.

(2). To try to effect a suitable combination between the hardiness of alfalfa and the fine growth of foliage and valuable grazing properties of black medick with a view to the development of a plant suitable for pasture purposes.

The first alfalfa mother plants to be used were selected from individuals from strains originally obtained from the United States Department of Agriculture, Washington.

The work was commenced in June, 1911, and carried on throughout the

[1] Darwin, Charles. The Effects of Cross Fertilization in the Vegetable Kingdom, p. 368. New York, 1877.

[2] Burkhill, I. H. On the Fertilization of Some Species of Medicago, L., in England. Proc. Camb. Phil. Soc., Vol. 8, p. 142, 1892-1895.

FIRST GENERATION OF THE CROSS

At the right is one of the hybrid plants produced by the cross of the black medick on alfalfa. It was numbered A6, and its flowers self-fertilized. From this selfed seed was produced the F_2 generation. In this second generation a considerable amount of segregation took place. In the first generation there was much variation, even between plants raised from seeds in the same pod. The plant shown at the left is a young shoot (Fig. 5.)

months of June and July until the middle of August without a single cross setting seed.

Owing to the hot and dry weather the flowers faded and dried in such a short time that great difficulty was experienced in obtaining sufficient flowers in a suitable condition for the purpose of hybridization.

Under such circumstances, in order to continue the tests it was found necessary to use any alfalfa plant, no matter to what strain it belonged, provided it was bearing healthy and vigorous flowers. While searching for such plants I found one growing in an adjoining discarded grass plot; it possessed a rich green foliage with an abundance of healthy, vigorous, violet flowers. A number of these flowers were emasculated and crossed with pollen from black medick which was obtained from the flowers of various plants growing as weeds in the vicinity.

From these crosses five healthy pods were obtained, the seed from which was sown in the fall of 1912, 24 plants being raised. The plants were kept in the greenhouse until the following year, when 19 were removed to the open field, the remaining five being planted out in July. These latter plants not having been treated uniformly with the rest have not been included in the present records.

In order to distinguish between the various pods they were designated by letters A, B, C, D, E. The number of seeds per pod varied from three to seven and in sowing, the seeds from the respective pods were numbered consecutively and kept separate throughout.

With two exceptions all the 19 plants grew vigorously and as they increased in size showed considerable variation; it was also very noticeable that plants produced from different seeds out of the same pod varied in quite a remarkable manner.

DIFFERENCES IN HABIT.

On referring to the photographs, it will be seen that some plants were tall with slender flexible branches whilst others were quite dwarf in habit with stout rigid branches and carrying a dense mass of leaves. During the period of growth it was observed that in several plants the young shoots which arose from the bases of the root-stocks were a very light pale yellow tint, in some cases almost white in appearance; but when the shoots became older they gradually assumed a darker tinge and finally turned to the normal green color of the rest of the foliage. It was seen, also, that the young seed pods of these plants were of a light salmon pink color which changed to brown as the pods became ripe.

As regards flower color, all the plants produced variegated flowers and the tints varied on almost every plant. The chief color was violet shading into purple; dark purple, and green. In some flowers the edges of the keel were lined with yellow but in no case was yellow seen on the wings or standard.

On most plants the flower structure was quite normal and required the usual operation to cause tripping to take place. Two plants were noticed which produced a number of abnormal flowers.

In structure these abnormal flowers had an enlarged keel which presented a swollen, unhealthy appearance, but contained the usual number of stamens enclosed. The pistil, however, did not remain enclosed in the keel as in the normal alfalfa flower but pushed its way out and the stigma in the form of a hook could be seen standing erect quite clear of the keel and fully exposed. In these abnormal flowers the standard was also much reduced in size and the whole raceme of abnormal flowers presented a very curious aspect.

By the above description it will be readily understood that it would not be necessary to trip such flowers to liberate the pistil.

These abnormal flowers were kept under close observation during the summer and as several produced seeds they were collected separately for the purpose of further experiment.

In view of the fact that these plants were raised under artificial conditions and that at the stage of growth as described previously they had only been planted in the open about three months, it is not thought advisable at this stage to give a detailed description of the different parts of the plants and their variations, but a table is here given setting forth some of the main characteristics noticed.

The measurements given in the table were taken from average individual shoots from the respective plants and it is from these same shoots that the accompanying photographs were prepared.

From plants of the first generation self-fertilized seed was obtained. One plant, C2, grew more vigorously and flowered much more profusely than any of the rest and as it yielded a fair amount of well-developed selfed seed this was sown in order to make a study of the second generation.

SECOND HYBRID GENERATION.

These plants were raised in the autumn of 1913 in the greenhouse laboratory of the Department of Plant-

Table showing some of the principal vegetative characteristics of the plants in the first hybrid generation.

Plant	Average height of plant, inches	Character of stem	Remarks on leaves
A_3	14	Thin slender	Many uniformly distributed.
A_4	11	Almost rigid	Medium in number.
A_5	$15\frac{1}{2}$	Thin slender	Not numerous.
A_6	$7\frac{1}{2}$	Rigid	Very many.
A_7	$20\frac{1}{2}$	Very thin slender	Very small, not numerous.
B_2	$12\frac{1}{2}$	Almost rigid	Numerous.
B_3	15	Medium	Many densely crowded above.
B_5	$12\frac{1}{2}$	Medium	Not numerous.
B_6	$14\frac{3}{4}$	Similar to B_3.	
C_2	23	Thin slender	Few sparsely scattered.
C_3	$6\frac{1}{2}$	Rigid	Many densely crowded.
C_4	$18\frac{1}{2}$	Stout not rigid	Medium in number.
D_2	$14\frac{3}{4}$	Not rigid	Resembles C_4.
D_3	$10\frac{1}{2}$	Almost rigid	Not numerous.
D_4	$9\frac{1}{2}$	Rigid	Many densely crowded.
E_2	7	Rigid	Similar to D_4.
E_3	$8\frac{1}{2}$	Almost rigid	Many uniformly distributed.

breeding, Cornell University, by the following methods.

The seed was first sprouted in small earthenware pans kept in a corn germinator. As the seeds sprouted they were at once removed and planted in $2\frac{1}{2}$-inch pots containing ordinary potting loam.

During the process of germination, after the seeds had been several days in the germinator at a temperature around 70 F., those seeds which still remained hard and dormant were treated by immersing them for 10 minutes in strong commercial sulfuric acid; the seeds were then washed free from acid and replaced in the germinator. This treatment usually caused them to sprout in one or two days.

In the case of some few seeds which were exceptionally hard a second 10-minute immersion in sulfuric acid was necessary to render the seed coat sufficiently soft to allow germination to take place. For a knowledge of this method of inducing germination in hard seeds I am indebted to H. H. Love,[3] Professor of Plant-breeding Investigations at Cornell University.

By the adoption of the method described above a practically perfect germination was obtained; hence the system can be strongly recommended as being well adapted for dealing successfully with one of the difficulties a plant breeder has frequently to encounter: viz., the task of inducing germination in hard seeds which do not readily respond to ordinary methods of treatment.

These plants have been raised and grown under artificial conditions exclusively and at the time of writing are not yet at their full growth and not in the flowering stage. It is not my purpose to enter into a full discussion as to whether or not there is any strict Mendelian segregation of characters; however, in order that whatever information has been obtained may be made readily available for future reference it has been thought advisable to place on record the results of observations made.

HEIGHT OF PLANT.

Taking first the character of "height of plant" it was found there was a range of from two to eleven inches, the increase from the shortest to the tallest being fairly regular (see fig. 6). There was no evidence of discontinuity between Talls and Dwarfs which might be looked for where segregation is in strict accord with Mendelian principles, hence a difficulty in dealing with this question

[3] Love, H. H. and Leighty, C. E. Germination of Seed as Affected by Sulfuric Acid Treatment. Cornell University, Dept. of Plant Breeding, Bul. 312, 1912.

SECOND GENERATION PLANTS

These plants represent types of the produce of the seeds from (C2), one of the first generation hybrids. The wide range of variation in height and habit of growth is strikingly shown. Although this variation was continuous, it was found, when the plants were divided in two groups, one of which (the erect) contained all plants above the mean, and the other (the non-erect) all plants below the mean, that these two groups closely approximated the expected Mendelian proportions, in their relative frequency. (Fig. 6.)

of height is to determine the exact point at which the plants should be divided on the one hand into Talls and on the other hand into Dwarfs.

After some consideration it was decided to take the mid-point of the measurements as the dividing line between Talls and Dwarfs; for example, any plants exactly half-way between the tallest plant and zero should be classed as Dwarf, while those having a greater height measurement than the mid-point should be placed in the Tall class.

When the plants were measured their average heights were found to vary from two inches up to eleven inches. Then taking the mid-point at 5.5 inches all plants which measured up to this height inclusive were placed in the Dwarf class; those above 5.5 inches being placed in the Tall class.

On analyzing the measurements it was found that the plants arranged themselves in the following manner:

Segregation of plants according to height.

	Found		Calculated	
	No. of plants	Ratio	No. of plants	Ratio
Tall plants all exceeding 5.5 inches in height	78	2.6	81	3.
Dwarf plants 5.5 inches in height and under	30	1.	27	1.
Totals	108		108	

If we accept the arbitrary standard of measurement used for grouping the Talls and Dwarfs, it will be seen that in view of the small number of plants studied the actual segregation is fairly close to theoretical expectancy, the Tall character being dominant and the Dwarf character recessive.

HABIT OF GROWTH.

A reliable determination as to whether there is any segregation in habit of growth is even more difficult to obtain than in the case of height; and as no simple measurements can be made to be of use, any determinations for purposes of classification must be made by observation.

A close inspection of the plants showed that as with height the variation in habit of growth was continuous. Beginning with the prostrate form as characteristic of black medick there was found to be a continuous series ranging through decumbent and semi-erect up to the erect form; this latter habit resembling the female parental form (alfalfa).

In order to resolve a continuous series of this kind into two groups the method was adopted of first classifying the plants into four subdivisions, then arranging the subdivisions into two main groups by which means the plants fall naturally into one of two groups one of which has been termed non-erect and the other erect, as shown in table below:

Segregation of habit of growth

Prostrate forms	3 plants	non-erect 88.
Decumbent	85 plants	
Semi-erect	12 plants	erect 20.
Erect	8 plants	

As will be seen by the above the prostrate and decumbent forms have been classed together as non-erect and the semi-erect and erect make up the other group, each group containing a series of forms.

Comparing the actual results with the calculated we have the following:

	Found		Calculated	
	No. of plants	Ratio	No. of plants	Ratio
Non-erect form	88	4.4	81	3.
Erect	20	1.	27	1.
Totals	108		108	

Reasoning on the basis of the above system of classification we have here also a strong suggestion of Mendelian segregation, the non-erect forms being dominant and the erect recessive.

For reasons already indicated I do not consider this study as furnishing conclusive evidence in support of the points under investigation, and it is proposed to remove the plants into the open field and after a more prolonged study under natural conditions to present a further statement which it is hoped may be more exhaustive and on which we may look with a greater degree of confidence than is possible at the present stage of the enquiry.

SUMMARY OF CONCLUSIONS.

1. There is need for a strain of alfalfa having superior properties to any at present in cultivation, especially in its power to produce seed freely under a great variety of conditions.

2. Alfalfa apparently does not seed freely in absence of suitable insects to insure fertilization of the flowers.

3. Wild bees of the Megachile species seem to be most effective in insuring fertilization.

4. Alfalfa flowers are not self-sterile and may be artificially self-fertilized with good results.

5. Black medick is capable of self-fertilization and produces seed freely even when insects are prevented gaining access to the flowers.

6. In the practice of hybridization of alfalfa better results are obtained by working on mature flowers than by operating on flower buds.

7. The cross between alfalfa and black medick is effected only with considerable difficulty and prolonged effort is essential to warrant success.

8. In the F_1 Generation hybrids the plants were variable and usually greatly different from either of the parental forms.

9. A study of the progeny of F_2 Generation revealed a tendency to Mendelian segregation both in height of plant and habit of growth, but further study is necessary to confirm these points.

10. The difficulty often experienced of inducing germination in hard alfalfa seeds may be successfully overcome by treating them with strong commercial sulfuric acid.

CONSTRUCTIVE EUGENICS

Agreement of Views of Lecturers, Starting From Diverse Viewpoints, Indicates That Scope and Methods of Science of Eugenics are Now Largely Fixed, and That Concrete Constructive Advance Through Education is Practicable.

A Review by The Editor.

THE publication of these lectures on eugenics,[1] delivered in 12 different universities last year, is significant—not because they contribute anything new to science but because they show that it is a science, with well understood bounds, and aims and methods on which its adherents agree, no matter how far apart their viewpoints are. Eugenics may not yet be an "exact science"; perhaps it never can be: but the day when each eugenist was a law to himself is passed. Its scope and, to a large extent, its methods, are now as well defined as those of any other of the sciences.

The lectures here printed, together with others on the same subject, were delivered in different American universities, through the initiative of Mrs. Huntington Wilson of Washington, D. C. As is to be expected, their appearance in book form entails a good deal of repetition of subject matter, since they are nearly all general in character. This is not a serious defect, however, and it is decidedly interesting to note just which points seem to have appealed strongly to all those interested in the propaganda. The variety given by the different viewpoints of the lecturers, who represent biology, sociology, economics, psychology and medicine, adds to the interest of a perusal of the book, and emphasizes strongly the point which the Journal of Heredity is attempting to demonstrate, that whatever the viewpoint and whatever the methods by which the problem of eugenics is approached, the problem is always the same.

It is, further, of particular interest to note that the constructive side of eugenics is emphazised by each of the lecturers. It is possible that this was a condition made when the lectures were arranged. In any event, it is an encouraging feature, for it indicates that the time is past when serious consideration can be claimed by a so-called eugenics whose sole ambition is to do negative work. Negative or restrictive eugenics is given ample attention in the book, as it deserves, but none of the lecturers assumes for an instant that purely negative work will solve the problem of race betterment. That, it seems to me, represents a decided advance which the science of eugenics has made during the past few years.

ACTION PRACTICABLE.

There seems to be a widespread misunderstanding as to the extent to which negative and positive eugenics are respectively practicable at the present time. Professor Bateson has recently issued this warning:

"It is evident that while the elimination of the hopelessly unfit is a reason-

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[1] Eugenics: Twelve University Lectures. Pp. xiii+348. New York, Dodd, Mead & Co., 1914. Price $2, net. Contents: Foreword by Lewellys F. Barker; The Eugenics Program and Progress in its Achievement, by Charles B. Davenport; Eugenics as viewed by a Zoologist, by Robert H. Wolcott; Eugenics from the Point of View of a Physician, by Victor C. Vaughan; Eugenics as Viewed by the Physiologist, by W. H. Howell; Eugenics: its Data, Scope and Promise, as Seen by the Anatomist, by Harvey Ernest Jordan; Eugenics from the Point of View of the Geneticist, by Herbert John Webber; The First Law of Character-Making, by Arthur Holmes; The Eugenics Movement from the Standpoint of Sociology, by Charles A. Ellwood; Eugenics and its Social Limitations, by Albert Galloway Keller; Selections from an Address on Eugenics, by William Herbert Carruth; Eugenics and Economics, by Morton A. Aldrich; Eugenics: with Special Reference to Intellect and Character, by Edward L. Thorndike.

able and prudent policy for society to adopt, any attempt to distinguish certain strains as superior and to give special encouragement to them would probably fail to accomplish the object proposed." . . . "It must suffice to point out that whereas our experience of what constitute the extremes of unfitness is fairly realizable and definite, we have but little to guide us in estimating the qualities for which society has or may have a use, or the numerical proportions in which they may be required."

Few will disagree with these judgments; yet they must not be interpreted too broadly. We can indeed segregate the feebleminded and epileptic, but that gives no warrant for so-called "eugenic legislation" restricting marriage, as Professor Bateson himself has vigorously pointed out on many occasions. On the other side, it is true that we can not yet breed intelligently for many definite points of social value; and yet it seems to me that all are agreed on certain fundamental principles which make constructive eugenics entirely feasible. Galton himself laid down the principle that the most important thing to breed for was energy; to this we may add good health, longevity, intellect and morality; for few will be found to deny that these characters form desirable attributes, and that they are heritable, even though we can not show the exact method of their inheritance.

This alone, it seems to me, constitutes ample warrant for all rational attempts to forward the constructive side of eugenics, and we can reinforce it by the proof, now abundant, that the effects of even the best environment are slight in comparison with the effects of these inherited forces—or the lack of them.

Evidently the 13 contributors to the book under consideration hold much the same views. Each one thinks the hope of the future is in influencing marriage selection by the force—conscious or unconscious—of public opinion. Dr. Barker seems to strike the keynote of the whole book when, in the introduction, he declares, "the cultivation of a healthy public opinion regarding marriage and parenthood will, it seems probable, be more efficient in promoting eugenics than anything that can be done by way of legislation, at any rate at present."

LIMITATIONS OF ACTION.

This, in substance, is the mode which all of the lecturers, from their diverse standpoints, agree in accepting as the practicable mode of procedure. There is no suggestion of breeding a superior race under live-stock conditions, as the lay press too frequently assumes to be the ideal of eugenists; indeed, as Dr. Carruth emphatically remarks, "The only extensive positive impulses to breeding given under civilization, so far as I can discover, have been the breeding of negroes and hybrids for slaves, the breeding of women for concubines in oriental countries, and the subsidizing of the breeding of men for cannon-food in various great imperial countries."

One after another, the lecturers arrive at the same position. None has a panacea to propose, but each one believes—and many give convincing reasons for their belief—that public sentiment can be so enlightened as to produce the ends which eugenists seek, without further measures. "Society may choose to breed from the bottom," as Dr. Thorndike puts it, "but it does not have to."

Dr. Howell, in common with nearly all of the speakers, holds close to the lines laid down by Galton.

"So long as we hold to our good custom of founding marriage mainly on affection and mutual attractiveness," he suggests, "it is a difficult and delicate matter to influence the direction that fancy may take. Mr. Galton looked at the subject in a practical and sensible way. He calls attention to the fact that it is our custom to allow many considerations to play a minor part in this question of selecting one's partner for life—considerations of race, or religion, of occupation, of financial standing, etc., etc., and what he hoped for was, that as a result of general education in regard to the influence of heredity, eugenical considerations may also take their part among those factors whose additive influence determines the choice that is made. This is a moderate and conservative suggestion, but quite suffi-

cient to give point to an educational propaganda. It is likely in the long run to prove wiser and more beneficial than an advocacy of more radical measures. In spirit and intent it accords very well with the advice of the wise and experienced in such matters at all times. 'Marry only for love,' said William Penn, 'but be sure that thou lovest what is lovely.' This sage aphorism may be interpreted to mean that we should so cultivate our appreciation of what is best in humanity as to be attracted only by those who possess desirable qualities. I fancy that this state of things is what positive eugenics hopes to accomplish or aid in accomplishing; not by force, not even by deliberate persuasion, but by bringing to the consciousness of educated people a realization of the fact that the welfare of the next generation will be influenced by the way they marry, as well as by the way they live."

PENSIONS FOR MOTHERS.

Dr. Ellwood diesusses and dismisses a number of proposals that have been made in the line of positive eugenics. Pensions to mothers and mothers' compensation do not appeal to him as desirable. "Are we going to put every service which individuals render to society upon a money basis?", he asks, "or are there not some services which we can not pay adequately for with money, and which we should not attempt to pay for with money, because it degrades them? Is not parenthood such a service? Would not the women who would accept compensation for motherhood be the very sort of women whom we might least desire to be mothers?

"We must, then," he concludes, "give up for the present, at least, the idea of the encouragement of parenthood in any material way. The whole question, therefore, of positive eugenics reduces itself at once to the question of the ideals of life which we should encourage in the young. It, therefore, becomes primarily a matter of education rather than legislation.

"This means, of course, that young men and women must, even at a very early age, be given right ideals of marriage and parenthood. If they are to make a more reasonable selection of mates, not only must the widest acquaintance between young people be encouraged by society, but they must also be given somewhat different standards of selection than most of them have at the present time. The ideals of good manners, social popularity, good looks, and wealth, must be replaced with the ideals of health, intellectual ability, and moral character. When these latter qualities come to be put first in the mutual choice of the sexes in marriage, there can be no doubt that the benefit to society will be incalculable."

Dr. Keller takes his stand squarely on the basis laid down by Galton. The latter hoped that eugenics would be "introduced into the national conscience like a new religion;" Dr. Keller recognizes the possibliity of such an event as being a proper field for the sociologist, and discusses it at length and interestingly. It is easy enough to talk about it; the question is, can society really control one of the strongest passions for its own purposes? Has it been able to do so in the past? He points to the taboos that have been in force at one time and another: taboos on consanguineous marriages, on exogamy, on endogamy, on polygamy; in some cases, indeed, effective taboos on all marriage, as with priests. Nor need we stop with primitive peoples, nor with the restraint of one passion alone.

EFFECTIVE TABOOS.

"Consider the case of the Hebrews in respect to the food taboo, and the taboo upon unions within certain degrees of blood-kinship. Consider the strength of the taboos lurking in present-day conventions respecting, say, the eating of human flesh or the marriage of the closest kin. If the same distaste were to forbid non-eugenic unions which exists to prevent the eating of the flesh of cats, the aim of the eugenists would be in large part attained." Or, to take a more frivolous and recent case, Dr. Keller mentions the former vogue of knee-length golf trousers, and the complete disappearance of them in the United States at present. "There is now a taboo—perfectly irrational in almost every respect—upon this style

of clothing. If non-eugenic unions should become as infrequent for a dozen years as golf trousers have been for that time, the eugenists could point to a golden era."

It is, then, evident that the goal of the eugenist is capable of attainment. "How can this be done? Or, to put it more concretely, how can unfortunate unions be effectively tabooed, as incest is tabooed?"

"All fruitful agitation for change must confine its aspirations within discreet limits. It must enlist sentiment, if it can, rather than reason; and the great compelling sentiment is fear. . . . Further, fear must be brought home. Some men are able to fear and worry for the far generations of mankind, but not many of us can get up much excitement over the fate of even our great grandchildren. Fear must be brought *home*, I say; and to the individual." Dr. Keller therefore urges that the knowledge of the laws of heredity be made widespread, and that physicians in particular be more active in making known the noxious action of some of the "counterselective factors" that are injuring the race.

Dr. Aldrich also expresses the problem in a concrete way. "How far is it possible," he asks, "for a body of thoughtful men, with an earnest conviction of the value of their eugenic teaching, to influence the formation and growth of a public opinion powerful enough to encourage parenthood of the fit and discourage parenthood of the unfit?" He would not belittle the difficulties of the task; but neither would he have them appear more insurmountable than they really are.

"When we consider the few years since the beginning of any systematic and wide-spread eugenic effort, and the difficulties in the way, the striking fact is that so much has already been achieved. . . . I do not think that any observer of American life will disagree with me when I say that there is already a marked tendency among the young men and young women of this country to look more carefully than they used to do to the physical and mental fitness of those whom they choose as their husbands or wives."

Dr. Wolcott emphasizes the need of "the conservation of desirable germ plasm by preventing the loss of manhood due to war, by enlarging individual opportunity, and educating the public to the desirability of more care in the selection of mates. Increased individual opportunity may be secured by subsidizing the fit, by a higher scale of wages, by a decrease in the cost of living, and by the removal of social hindrances to marriage such as the increasing demands of professional and business life. The methods of procedure last outlined again carry us over into the field of euthenics, which we have seen from so many points of view lying close to that of eugenics."

ALLIANCE WITH EUTHENICS.

Dr. Jordan, too, points out in a vigorous way the tremendous reversal of natural selection which is caused by war. He suggests the endowment of parentage, but believes the scheme must be safeguarded with many checks and qualifications. He looks to the church as a potent factor in the educational compaign to create the eugenic conscience which he hopes to see the public acquire.

Dr. Webber, recognizing the need for encouraging parentage among the superior, also recognizes the need for better standards or methods of judging ability early in life. As an aid to the development of the race he urges "the great importance of establishing an adequate system of human registration similar to that used in the registration of pure bred stock.

"Such a human registration would serve many useful functions. First and primarily, it would stimulate pride in family and the desire on the part of any individual whose ancestors were in the register to measure up to or surpass that standard. I believe that family pride is the most potent influence in restraining the individual from error, and in stimulating him to greater effort.

"Such a register would include only good and superior individuals, as mediocre or poor grade individuals would never seek to be included in such a pedigree record.

"Once started I believe such a regis-

tration would be sought by all of the best individuals of society and soon it would come to be almost universal among good families having pride or confidence in their ancestry. Soon, if one is not registered or his family is not registered, the question would arise, why are they not registered? In this way I believe all individuals and families that have not very serious defects in their pedigrees would be led to register, and thus the object would be accomplished, as we could then be certain that unregistered families could not be considered good constructive eugenic material.

A GUIDE TO MARRIAGE.

"Such a register would have great value, doubtless, as a guide to marriage. Suppose a father notices a growing intimacy between his daughter and a young man of apparently good character but of unknown ancestry. The registration number of the young man's father or mother could be obtained and from this, for a small fee, the girl's father could secure a brief outline of the young man's family history. If this history were bad doubtless it would serve to check any growing intimacy between the two and would save the family much trouble and worry."

Dr. Davenport makes clear one feature of the program which some of the other lecturers implied rather than directly stated. "It is not sufficient to secure good matings and cut off the bad," he points out. "The eugenic marriages must be fecund, and must equal or exceed the fecundity of the cacogenic matings. No fact is more startling today, and fraught with greater danger to the commonwealth, than the low fecundity of our best blood.

"From 1193 bachelors of arts of Bryn Mawr college since 1888 there have been produced to January, 1913, 263 girls all told. Twenty years after graduation, close to the reproductive limit, 328 graduates of Harvard in my class have reproduced 195 sons to take their place. An earlier class of 278 persons, 25 years after graduation, had produced 141 sons, or had only about one-half reproduced itself; and no account is made of infant deaths. Assuming that a class produces half as many sons as it graduates, and that their descendants do the same for six generations, 1000 Harvard graduates of the 1880's will have 16 male descendants of the 2080's. These 16 sons will be ruled by the scores of thousands of descendants of 1000 of the Rumanians, Bulgarians, Greeks and Hybrid Portuguese of the 1880's. Such figures must make one fear for the future." He therefore advocates examination of the family history of immigrants, in order to reject those who are manifestly undesirable breeding stock.

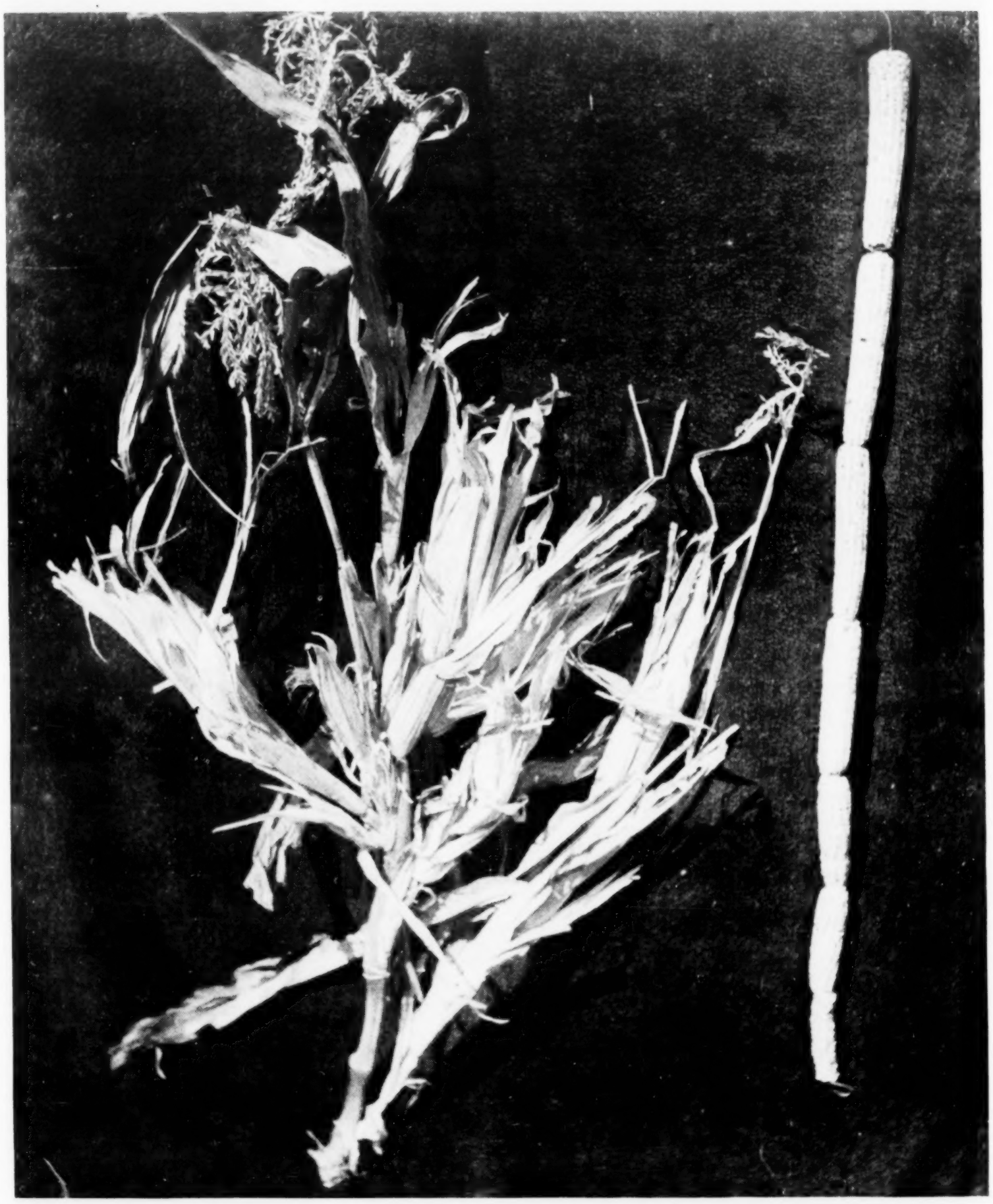
Summing up his own paper, he says: "Thus the program of eugenics stands; first, investigation; then, as knowledge grows, education. Finally, legislation based on sound public sentiment. For the carrying out of this program the public is quite ready and indeed waiting. It is seeking to be wisely led."

NEGRO-UTE METIS

ABOVE—NEGRO-UTE HALF-BLOODS. BELOW—PURE-BLOOD UTES

The accompanying photographs were taken by the writer at the time of a visit, in April, 1910, to the Southern Ute reservation in southwestern Colorado, in the company of John P. Harrington of the School of American Archeology at Santa Fe, New Mexico. The picture of greatest anthropological interest is the upper one, portraying, as it does, a not very common instance (in that region, at least) of race mixture. The boy and girl are brother and sister, children of a Negro father and full-blood Ute mother. They live on the farm allotted by the government to the mother. The Negro characters are most apparent. Some features, however, especially the hair, show Indian influence. The hair, particularly that of the girl, recalls a type found among many of the Oceanic blacks. The skin has the distinctively Negro chocolate color. For comparison, I present, below it, the picture of two typical Ute girls. The four children are of about the same age, and were all pupils in the day-school a few miles north of Ignacio agency.—Albert N. Gilbertson (University of Minnesota, Minneapolis, Minn.), in American Anthropologist, n. s., 15, p. 363, (1913). (Fig. 7.)

HIGH ALTITUDE MAIZE



The above photograph (Fig. 8) shows a stalk of one variety of my acclimatized corn with its product. I have been making an effort to get a stalk of corn of which the aggregate ear-length would equal the entire length of the main stalk, and I think I will finally succeed. Since high altitude, low temperature and lack of humidity decrease all vegetal factors but do not effect reproductive virility, the environment is favorable to this effort. The specimen is a hybrid from unidentified parents, both of which have been grown at an altitude of over 7,000 feet for quite a number of years. It has been cross-bred with several varieties with a view of increasing the forage, but did not succeed until mated with sweet-corn—the forage was then increased 75 to 100%. I am sure that by this process a valuable corn for silos in dry farming districts can be produced.

The length of stalk shown is 50 inches.
Aggregate ear-length 43 inches.

Two ears,	12 rows per ear, 46 grains per row:	1104 grains.
One ear,	12 rows per ear, 40 grains per row:	480 grains.
One ear,	12 rows per ear, 34 grains per row:	408 grains.
	On suckers:	
Two ears,	10 rows per ear, 28 grains per row:	560 grains.
One ear,	8 rows per ear, 15 grains per row:	120 grains.
	Total number of grains of corn on plant - -	2672

A. JAY GARRISON.

Edgewater, Colorado.

RACIAL HYBRIDIZATION

Studies of the Offspring of Boers and Hottentots—Mendel's Law Seen in the Inheritance of Many Characters—Racial "Prepotency" Not Found to Exist—Mankind a Single Species.

EUGEN FISCHER[1]

THE author has taken in hand a problem that leads him into wholly new fields, which hitherto have hardly been worked—the investigation of a hybrid race. The material is the most valuable he could have selected, the mongrels of Rehoboth, the product of miscegenation between Boers and Hottentots. The physical anthropology of these hybrids, especially all phases of it that concern race mixtures, naturally makes up the most valuable part of the book.

The racial mixture here is not such as we usually find, the result of irregular unions which produce a racial proletariat that defies all anthropological analysis. We have, instead, a well-defined race of mixed ancestry, with definite, fixed characteristics; we can measure the proportions of each stock which it contains. It is a mixture that has risen to the rank of a new race.

When, in the eighteenth century, Dutch and Low German peasants penetrated the country, defence against their common enemy, the Bushmen, brought them into close contact with the Hottentots. Of course, there were few European women in that raw land, given over to nomads and hunters. Consequently, we find many half-blood children, of Hottentot mothers and Boer fathers. The primitive life of a Boer "on trek" was not very different from that of the aborigines; consequently, it is not surprising that a great many of the Boers took Hottentot maidens in life-long marriage. The racial pride of the pure Boer families thrust out these results of mesalliance; but the mulatto sons also partook of the racial pride of their fathers, and married girls of the same origin as themselves—not caring to marry pure Hottentots and not being able to obtain white wives. We thus find at the present day hybrids of two degrees.

HOLLANDERS PREDOMINATE.

Family traditions, particularly among the older generations, have extraordinary vitality, so that the genealogies claimed by various branches of a family are in entire agreement. Of the 27 men who are recognized as founders of mixed families, 17 are Hollanders, 11 Germans, and nine of unknown origin. Other European men came later, taking Hottentot girls in marriage; occasionally there is a birth outside of wedlock. On the whole, these European founders of families are preponderatingly Low German; it may be added that the nordic race preponderates.

The female ancestry is somewhat easier to analyze, for no other women than Hottentots are mentioned. Occasionally, however, there is no doubt that a Boer married a Damara or Herero girl.

The material which Fischer used, with great skill, consists of 310 men, women and children, studied anthropologically, and 300 additional cases studied through photographs. The author divides his material into three groups. One group of hybrids continue to marry *inter se*—these he calls "middle" hybrids. Opposed to them are two

[1]Fischer, Eugen. Die Rehobother Bastards und das Bastardierungsproblem beim Menschen: Anthropologische und ethnographische Studien am Rehobother Bastardvolk in Deutsch-Sudwest-Africa. Jena (G. Fischer) 1913. Translation and abridgment of a review by Mollison of Heidelberg in the Zeitschrift für Morphologie und Anthropologie, Stuttgart, 1913; Bd. XVI, Heft 2, page 397.

other groups, "crossed out" with Europeans and Hottentots respectively. Pure European blood was always introduced by a man, pure Hottentot blood by a woman. In the individuals of the last two groups, the proportion of the two stocks represented is diverse. The most extreme grade is the result of direct outcrossing, such as is given, for instance, through the marriage of the son of a European with a girl of mixed origin of the first generation. The three groups are briefly designated as the Eu-group, mid-group and Hott-group, according as one or the other blood, or neither, preponderated. As a "control" group for comparisons in his measurements, Fischer took peasants of Baden, there being no available observations on Hollanders. The only comparative measurements on pure Hottentots were those made by Fischer himself, on eight men and seven women.

The stature of the mongrel men (average 168.4 cm.) is considerably greater than that of the Hottentots (157.9 cm.) and even somewhat above that of present-day Hollanders (167.5 cm.) or of the South Germans (167-168 cm.). The women are much shorter than the men, the difference of about 11 cm. being about the same as with the population of Baden, while among the Hottentots the difference between the sexes seems to be somewhat less. The mean of the Eu-group is 174, that of the mid-group 167, and that of the Hott-group 168 cm. for the men, or 160-157-157 for the women.

WOMEN BECOME OBESE.

The women show the same tendency to lay on fat which characterizes the Hottentot women; the men do not have this tendency. It begins to show itself from the fifteenth to seventeenth years and reaches its maximum at the age of 30. This may be due to environment rather than to heredity.

The form of the skull is understandable as a combination of that of the Hottentot and European forms; but the skulls of the Eu-group are notably nearer to those of Europeans and those of the Hott-group to the skull-form of the pure Hottentot.

The facial appearance is decidedly variable. Measurements show that the hybrids mostly are intermediate between pure forms of the two races. The nose is never either entirely European or entirely Hottentot.

A test showed that the individuals of the three groups could be accurately distinguished by their general appearance.

The skin of the hybrids is dry and little turgescent, as with Europeans. In color it is tolerably light—portions of the body which are covered with clothes show a lighter tint than that of the skin of the Mediterranean race. Many individuals have a darker tint, but it is seldom a pronounced brown. The frequency of lighter and darker skins follows rather closely the degree of racial-mixture. The hair form is extremely variable, ranging from smooth to very curly. Its color is usually black. That of the children is usually lighter, whereas Hottentot children show black hair from its first appearance. Fischer leans to the belief that when hair darkens in adult life, it always indicates racial-fusion somewhere in the ancestry of the individual concerned.

Light eyes are much more frequent in the Eu-group than in the Hott-group, and in one instance pure blue eyes are found; the mid-group holds an intermediate place in this connection. It is notable that wholly dark eyes are rarely found even in the Hott-group.

MENDELIAN COMPUTATIONS.

The second and most important part of the book deals with the results that an investigation of these hybrids offers to our knowledge of the laws of heredity. The prevalence of Mendel's law naturally occupies the most important position, preceded by an analysis of the unit characters.

The relative frequency of straight and waved hair is found, in the second generation of the mid-group, to be about that expected by Mendel's law; 18% smooth and 82% curly, as compared with the 25% and 75% expected from theoretical calculation. The proportions of straight hair with the Eu-group (48%) and the Hott-group (17%) are also comprehen-

sible on the same formula. By back crossing of equal degree with Europeans and Hottentots, the whole population must be the equivalent of an F2 generation, that is, one-fourth straight-haired and three-fourths wavy-haired. The reality (71:228) accords satisfactorily with this expectation. Davenport's discovery is also confirmed, that the hair-form Mendelizes with the formation of an intermediate type in the heterozygotes, among whom straight hair is recessive and curly hair dominant.

The figures for light and dark eyes also accord with the Mendelian expectation demonstrated by G. and C. Davenport and Hurst.

It is evident that the relative breadth of the skull follows Mendel's law; and none of the other dimensions of the face seem to be inherited in an intermediate stage.

The appearance of the eye also closely conforms to the Mendelian expectation, 25% being oblique and 75% level. The proportion in single families is close enough to these figures to be considered confirmatory.

The small, high form of nose seems to dominate the low, broad one. The feminine appearance of the faces of the mongrels seems to be due to the independent inheritance of unit characters.

Proof that the investigator's views as to dominants and recessives are well founded, is furnished by the first generation hybrids—that is, the product of marriages between white men and Hottentot women. Fischer could not find many such children, but an examination of those whom he did discover satisfied him that the theoretical expectation was fulfilled; as did the results of crossing back, between mongrels and either one of the parent races.

ONE LAW FOR ALL LIVING CREATURES.

He is thus convinced that for a long list of characters the mechanism of heredity is the same when races of mankind are crossed as when breeds of livestock and varieties of plants are hybridized.

The increased stature of the hybrids is probably explainable through the well-known vigor resulting from crossing, although it can not always be determined that such a result is not due to the environment. Perhaps the vitality and low death-rate of the hybrids is explainable on the latter basis, since it is in decided contrast to the observed result in other cases (for example, the mulattoes resulting from a cross of English and negroes), where the power of resistance seems to be lowered by the cross. At present we can not account for the fact observed by Hagen among Tamil-Malay metis, and by Fischer among the subjects of the present book, that the countenances of the hybrids are longer than those of either parent race. It is possible that we are justified in suspecting a correlation with the increased bodily vigor.

The fecundity of the hybrids appears not in the least to be diminished. It does not seem possible to pass dogmatic judgment on the fecundity of racial crosses in general. It is only certain that all races are fertile with each other, that the hybrids are fertile with either one of the parent races—although it is questionable still whether the fertility may not be diminished; that the hybrids are fertile *inter se*, although in many cases the fecundity seems to be diminished; and finally, that the factors on which this result depends, are unknown to us.

Another chapter takes up the question whether a new race can be formed through crossing. The first generation hybrids are certainly not a new race, but merely a patch-work of characteristics inherited from their parents. But in a later generation appearances are very different. As the unit characters are separately inherited, the chance for a given individual to inherit all or most of those of one of the parental races becomes steadily smaller. The characteristics of the parent races, therefore, are still present after any number of generations, but the resemblance of individuals to either parent race has become less (excluding, for the moment, all questions about the influence of environment). When a hybrid population has once become established it therefore remains con-

stant with respect to the inheritable anthropological characters.

THE IDEA OF PREPOTENCY.

The hazy conception of a "prepotency" in transmission is referred by Fischer to its most plausible origin, the accidental combination of numerous dominant characters. He tests the question of whether there is a racial prepotency by means of curves, which show the genealogically middle-group to hold exactly a middle ground between its two parent races. He therefore concludes: "A prepotency of either of the parent races, a stronger tendency of the hybrids to resemble either one of them, does not exist. On the average the hybrids occupy an exactly intermediate position. One can not talk safely of a prepotency." An apparent preponderant influence of any race in transmission merely indicates that it possesses many characters which behave as dominants.

Mathematical computations failed to discover any correlation of the characters shown by hybrids; in consequence it must be assumed that the characters of the two parent races act entirely independently in heredity.

Consanguineous marriages are very frequent among the hybrids. No evil results have ever been noticed from them, but an increased sharpness of family types is produced.

As the end-product of hybridization, Fischer does not admit the formation of a new race, since that would require blended inheritance of at least a number of important characteristics. From his views on heredity, he concludes that mankind as it exists today forms but a single biological species.

Mme. Montessori's View

The most interesting biological researches of today are in regard to the hereditary transmission of characteristics.—Maria Montessori.

PRIZES OFFERED FOR PHOTOGRAPHS OF LARGE TREES

TWO prizes of $100 each are offered for photographs of large, wild, native trees in the United States, by two members of the American Genetic Association, who are interested in forestry and wish to secure data along somewhat novel lines. These prizes are to be awarded as follows:

One hundred dollars for photographs of the largest nut-bearing tree. This includes chestnuts, oaks, walnuts, butternuts, pecans, etc.

One hundred dollars for photographs of the largest shade or forest tree, not nut-bearing. This includes such trees as the elm, beech, poplar, tulip-poplar ("yellow poplar" or "tulip tree"), etc.

Photographs of conifers will not be considered.

All photographs must be submitted to the JOURNAL OF HEREDITY before July 1, 1915, and will become the property of the Association. Photographs must be taken by or under the direction of those who send them in, and not purchased from professionals or collections. Competition is not confined to members of the American Genetic Association, but is open to the public.

It is hoped that a collection of photographs, such as should result from the offer of these prizes, will furnish some reliable information about the maximum size attained by North American trees, and the regions and conditions under which they attain their greatest development. It is further hoped that seed or other material from the largest specimens may be used for propagation. In order to make these offers yield the necessary information, contestants should comply with the following conditions:

Photographs must be on glossy paper, not smaller than 4 x 5 or $3\frac{1}{4}$ x $5\frac{1}{2}$ inches, and must be of sufficient excellence to allow reproduction in the JOURNAL OF HEREDITY or elsewhere. Photographs in which the tree is so small that its details can not be made out, can not be considered. As much information as possible should be furnished about the tree in question, and exact identification is particularly necessary. For this reason the photographer should send a branch with leaves and, if possible, flowers or nuts, in order that the Association may identify it. The measurement of the tree must be given in detail. In making it the only method which may be followed is to take the circumference of the trunk at five feet from the ground. The trunk must not be measured at a point where its girth is increased by the juncture of a branch; if it is so swelled at a point five feet from the ground, the measurement should be made at the smallest diameter above the basal swell and below the swell of the branches. In such a case the fact should be stated when the photograph is sent, and the exact point at which the measurement is made should be indicated. It is desirable that the full height of the tree and spread of branches, as well as the girth, should be stated; if they cannot be measured exactly, they should be estimated. Photographs should, when possible, contain some object, such as a human figure, or a horse and buggy, which will aid in giving a realization of the size of the tree; but such figure should be beside, not in front of the tree. It is necessary that one photograph should include the whole tree. If there are other trees growing beside it and cutting off part of it these other trees should be included in the picture. A second photograph of the same tree should be sent in, showing the trunk only, with a little foreground. Each contestant is thus required to send in two photographs of the same tree, one showing the entire tree and the other the trunk only. Contestants may send photographs of as many different trees as they like.

With each photograph, a statement should be submitted telling all that is known about the tree, with reference to its age, its fertility, the quality of the nuts (if it bears nuts); the character of the soil and surrounding vegetation. It is particularly necessary that photographers should state whether there are many other very large trees of the same species in the neighborhood—within a radius, say, of five miles. If the tree is on private land, and likely to be destroyed, the fact should be mentioned. If there are any historical or literary associations connected with it, these should also be mentioned. It will be helpful if photographers can tell to what extent the tree is subject to attacks by disease or insects. In short, the council desires to gain as much information as possible about the largest trees of the United States; but it imposes as few hard-and-fast restrictions as possible, because of the varying conditions under which photographs may have to be taken, or under which they have been taken at some time in the past.

It is immaterial whether the tree is shown with full summer foliage, or defoliated in winter condition.

The council will be glad to furnish information on any problem connected with these offers; it will judge the photographs submitted, and reserves right to decide any disputed points. Only the two capital prizes will be given, but all other noteworthy trees will be mentioned in the final report. The prizes are offered by Mr. Charles Deering of Chicago and Mr. W. A. Wadsworth of Geneseo, N. Y.

The Human Breed.

To be a good animal is the first requisite to success in life, and to be a nation of good animals is the first condition of national prosperity.—Herbert Spencer.

Men are commonly more careful of the breed of their horses and dogs than of their children.—William Penn.